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Electrical Review

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CONTENTS:

	PAGE
The Prosperity of the Electrical Industry in Germany	129
Engineering and Experience	130
Notes on Light	130
The Prosperity of the Electrical Industry in Germany	131
Personal	132
Electric Lighting	132
Views, News and Interviews	133
A Water Rheostat Motor Controller	133
A Decision in the Washington Telephone Case	133
Thomas A. Edison Down With the Grippe	133
Rumor of an Automobile Trust	133
The Electrical Equipment of the Union Traction Company, Philadelphia	134
Science Brevities	136
Mr. C. S. Bradley	137
Electric Lighting in Greece	137
Mica Production in the United States	137
Electro-Mechanical Battle Order Telegraph	138
Wall Street and the Electrical Stock Market	140
A Handsome Rubber-Covered Cable Exhibit for the Paris Exposition	141
Berlin Iron Bridge Company	141
A Westinghouse Dividend	141
National Carbon Company	141
Removal of J. H. Bunnell & Company	141
Electric Storage Battery Company	141
American Steel and Wire Company	141
An Automobile Attachment for any Vehicle	142
Adventures of Long-Distance Telephone Lineman	142
As to the Trolley Car	142
American Electric Vehicles at the New York Bicycle-Automobile Show	143
Telephone and Telegraph	144
A Query for Telephone Manufacturers to Answer	144
Montauk Multiphase Cable Company	144
An Advertising Experience	144
Niagara Power Development	144
The Electric Fish of the Nile	145
Damages for Injury Due to Defective Insulation	145
British Notes	146
Our Canadian Letter	147
A Universal Adjuster for Incandescent Lamps	147
Rifle Vibrations	147
The Common Battery System	148
Export Notes	149
Passengers Must Jump Off	149
Electric Railways	149
Mr. George Westinghouse and Dr. Hutchinson on the Use of Refuse as Fuel	150
Sparks from the Daily Press	150
De Rodays and De Castellane	150
Industrial Notes	151
Advance Information	152
Electrical Patents	27

Advertisers' Index, page 16.

THE PROSPERITY OF THE ELECTRICAL INDUSTRY IN GERMANY.

Probably the largest competitors which the American manufacturers of electrical apparatus will meet in their struggle for export trade are the large German firms engaged in the same line of work. The article on another page treating of the present extraordinary prosperity of these concerns is well worth careful reading. It appears from it that one of the largest factors of German success in electrical manufacturing work has been the support given by capital to the electrical industry. It might be added that this support is intelligent. In America there has been no lack of support on the part of individuals and banking corporations who have liberally financed many electrical schemes, but this support has not always been as intelligent as the situation has demanded. It was not many years ago when there was a widespread tendency on the part of investors to rush into electrical investments of any and all sorts. Anything that bore the name "electrical" had a certain magic significance and seemed to have the power of extracting gold in unlimited quantities. It was soon found out, however, that many of the electrical schemes that were presented to the public were of such a character as to render investment in them almost certainly unremunerative, while a few were even fraudulent. The effect of this discovery upon the mind of the investor was for a long time to discourage the venture of capital in legitimate electrical enterprises.

In Germany, on the contrary, the growth of the vested electrical interests seems to have been more steady, and one reason for this is found in the fact that shares in electrical enterprises are scattered among large numbers of holders, the individual holdings being comparatively small. In addition to this, the middleman or promoter apparently has no place in that country, the electrical concerns being associated to finance their own undertakings and very frequently procuring concessions and building railway lines and electric light plants entirely under their own auspices. In this way they have not had to wait for the organization of companies of sufficient financial strength to carry such undertakings, but have themselves been bank, promoter and building company in one.

It is not likely that such a system as this would ever gain ground in the United States, and its existence, while doubtless of benefit to the home consumption of the output of these German concerns, does not seem to be of any great benefit to their export business except indirectly. The maintenance of large works and well-equipped manufacturing plants means the ability always to sell certain portions of the output abroad easily and to meet competition from outside sources. In one respect the American manufacturer will have little to fear from his German competitors; American goods are intrinsically better. The method adopted in this country of manufacturing all kinds and classes of articles strictly to gauge and with interchangeable parts, is little followed abroad, and it ought not to be difficult to convince intending buyers of the vast superiority of machinery and supplies built upon this system. Some of the largest individual construction concerns in Germany are, however, now introducing purely American methods in their establishments, and the future may find them more dangerous competitors than they are to-day.

A recent advertisement describes the merits of a new means for curing rheumatism. As the disease is caused, says the advertisement, by "an excessive flow of electricity from the body to the earth," the treatment consists of glass bed casters for use by night and insulating insoles for the shoes by day!

ENGINEERING AND EXPERIENCE.

The country is liberally provided with three classes of engineers—those who have had a training in an engineering school and nothing more, those who have grown up to be engineers by actually doing the work of some branch of engineering and familiarizing themselves with its details through practical experience, and a third and highly valuable class who have combined the tuition and training of the college with the knowledge and practical experience of the man who has worked with his hands. In his own sphere each of these men is able to do good work and each has his place; but it can probably be proved, as it is certainly believed, that the man of the third class—he who unites knowledge gained both from the expressions of experience of others as set down in books and from his own experience as gathered in actual work—is far superior to the other two for most purposes for which an engineer is required.

Looking at it broadly, the duty of an engineer is to apply his knowledge and skill for the benefit of those who employ him and who do not possess his degree of acquaintance with the subject upon which he works. He is supposed to know intimately the details of his profession; he is an official whose duty is to obtain the most result with the least expenditure of money, time and labor under given conditions; his stock in trade is simply the knowledge of how work should be done in order that such results may be obtained. It is easily conceivable that a young man possessing a high degree of intelligence and trained in the best engineering maxims by competent schools would often be able to do as good work under some conditions as any other engineer whatever. It is equally certain that for many varieties of work the man whose knowledge is confined to that which has been driven into him by the hard knocks of experience, the man who has learned his business "from the ground up" by actually doing the various kinds of work that he is called upon to oversee, may be far more useful than the school-bred man; still it is not difficult to imagine circumstances in which the latter would easily prove his superior.

It is, however, in the overcoming of difficulties as presented by emergencies, in the sudden and swift solution of problems which present themselves in regular work, that the engineer is most needed and most often lacking. To this class of work the man who expects to succeed must bring not only an adequate training and an orderly knowledge of the subject involved, but as well he must know what he can learn only from practical work—that inexpressible something which stamps the practician and man of affairs. Hence, in the larger undertakings where much is involved, the engineer who combines practice with what is commonly called theory is the best man. His experience forbids that he should err in attempting that which is only apparently possible; it forbids that he should undertake to put into force the rules of textbooks without that modification which almost every practical example enforces upon them; it gives him the ability to seize the opportunities often presented in practical work and to make the best of the situation.

It is not to be thought that this is any argument against either the mere practician or the merely academic engineer. We need both; but what we most particularly and urgently need at all times is the combination of both in one man. It is to this combination, to the existence of men who have combined in the highest degree the faculties attained only after years of hard labor in the actual doing of work and the knowledge of textbooks, that this country owes its astonishing preeminence in matters of engineering work.

NOTES ON LIGHT.

BY WILLIAM ROLLINS.

NOTE LXXXVI—THE CHARGE ON THE PARTICLES OF THE CATHODE STREAM.

One charm of a theory is the excuse it gives for trying an experiment. Though the theory may not be proved, the beauty of the scene compensates for the outlay. An interesting theory is that the velocity of the particles of the cathode stream is the same for all gases. A few simple experiments I have tried lead me to think that the experiments which were supposed to prove this theory may be otherwise explained by saying that at the degree of vacuum used for X-light the charges in the cathode stream are carried by hydrogen whatever the nature of the gas with which the tube is supposed to be filled. In connection with the idea of a constant relation between mass and charge, which is a part of the theory mentioned, I describe an experiment that no doubt has been made many times before, though I have not seen it mentioned in connection with this theory. Pump an X-light tube such as is shown in Fig. 65 until using the full force of the generator it gives brilliant X-light. Then introduce hydrogen through the electrolytic regulator shown in Fig. 65, and in detail in Fig. 68. Continue the pumping until the vacuum is practically all hydrogen. Stop the pump when the fluorescent screen is bright, but the bones of the hand only faintly visible.

In this condition the ether waves we call X-light are the longest which will pass through the flesh without suffering diffusion as do those of ordinary light. According to the theory advocated in my notes there is then an amount of charge on the particles of the cathode stream which causes them to strike the target with a certain speed which I call unit velocity for X-light. Next, continue the pumping until the image of the hand is brighter, the image of the bones relatively brighter, with their structure sharply defined. This changed appearance is not due to more force being sent through the tube, for we used the full force of the generator in the first instance, but is due to the way the force is expended. I explained this in my earlier notes by saying that the velocity of impact was now greater because the charge on the particles was higher, in consequence the temperature of the particles was higher and the resulting ether waves shorter. This and other experiments lead me to say that before the beautiful theory of J. J. Thomson of a constant relation between mass and charge can be said to be firmly established it should explain these phenomena. The word particle has been used in these notes instead of molecule, ion, atom, hyperatom, neutron or electron, for it serves as a symbol to fix the attention without committing us to any theory as to the ultimate nature of mass or charge.

THE PROSPERITY OF THE ELECTRICAL INDUSTRY IN GERMANY.

During the past 15 years the electrical industry has attracted an ever-increasing degree of interest from the German capitalists, and it can now be placed in the front rank of the large industries of the country.

Up to the present the industry has justified the confidence of capital, as with the exception of a small percentage of unavoidable failures, it has paid high and increasing dividends on the capital invested. There is no doubt good reason to believe that not only will this prosperity continue, but that it will increase in the future, as the German electrical firms have understood how to organize successfully, and they are extremely well managed. The weaker and less solid undertakings were eliminated early, so that now the solid enterprises are not subjected to the injury which the failure of some unsuccessful undertaking often causes a whole industry. At present the field of the industry is large and profitable, the exportation of its products being carried on on a large scale and where they are often brought into competition with the products of the American industry. In addition, new and profitable fields are constantly growing up to it in Germany, such as the operation of electric railways, the supplying of current to the greater part of a province, and the establishment of plants for the constantly developing electro-chemical industry.

The factor which has helped in a large measure to establish this success is the not inconsiderable support given it by the leading banks of the country. German capital invariably seeks industrial investments and helps to establish all electrical enterprises, resulting in the immense development of which the following figures will give an idea.

From July 1, 1897, to July, 1898 (26) twenty-six railway or tramway companies, with a capital of 69,628,000 marks, were established. During the same period, the capital stock of existing companies increased 106,180,142 marks, and their liabilities 95,680,000 marks. The capital stock of the (23) twenty-three leading companies (excluding all those with a capital of 1,000,000 marks or less) in January, 1899, was 339,000,000 of marks, of which 302,800,000 marks was paid up, and the liabilities of the same companies were 102,160,000 marks, or a total capital invested in the leading companies engaged in the industry of 441,000,000 of marks. Several of the leading companies have since increased their capital, such as the issue by the Helios Company, of Cologne, of new shares to the value of 3,000,000, so that it is safe to estimate that a capital of 500,000,000 marks ($119,000,000) was invested in these 23 companies at the end of December, 1899.

If to this sum be added the resources of the smaller companies scattered throughout the empire, it can conservatively be estimated that the total amount of capital absorbed by the industry in Germany is fully 550,000,000 marks ($130,900,000), on which the average returns in the shape of dividends during the past year were nine per cent.

In January, 1899, the number of towns and cities in Germany having electric street railways for public traffic, exclusive of those having lines for the use of mines and factories, was 74, and the total mileage of all the lines was 1,429.55 kilometres; the length of the rails in use being 1,939 kilometres.

The number of motor cars in use was 3,190, other cars 2,128, and the power used in running these lines amounted to 33,333 kilowatts exclusive of accumulators, of which the power amounted to 5,118 kilowatts, making a total of 38,451 kilowatts of power in use on the street railways of the country.

Since then a large number of roads have been built, such as the ones in Meissen, Weimar, Eisleben, Karlsruhe, Gleiwitz to Morgenroth, Glauchan to Crimmitschan, Dusseldorf to Crefeld, etc. Others are now under construction, such as the ones in Pforzheim, Frier, Ratisbon, Colmate and Worms, and many more are being planned for the remaining cities and towns of 5,000 population and over. However, it is next to impossible for American or other foreign firms to compete with the native ones for the supplying of the materials and machinery for these roads as by a system that will be explained below, the leading electrical companies preclude all possibility of competition. The only way for foreign electrical firms to enter this field would be for them to obtain the concessions and construct and operate the roads themselves.

As before stated, the banks of the country have backed the industry heavily and in this fact seems to lie the principal danger to the continuance of its success.

This statement and the system excluding foreign competition can best be explained by stating that such firms as the General Electric Company, Siemens & Halske, Schuckert, Helios Company, and many others of the 23 leading ones have connected themselves with a bank or group of banks in order that they need not look for customers for their products. For example, instead of awaiting until companies are organized for the construction of electric railways, or the erection of light or power plants, and then entering their bids for the supplying of the requisite materials and machinery, these double-headed electrical concerns procure the concessions, erect the plants or build the lines at their own expense, and as soon as the line or plant is in operation, form stock companies, the shares of which are kept by the banks until the success of the enterprises seems assured, when the shares are sold at a premium for the benefit of the banks.

The extent to which this system has been adopted is not generally known, as the electrical firms often associate themselves with seemingly independent companies, which are in reality formed solely to organize the various undertakings and manage the finances, and are simply the agents of the electrical firms (supported by the banks) for the purpose of keeping their operations hidden from the investing public.

It would seem that stocks which are more easily handled have taken the place of the merchandise produced by the electrical firms, and it can readily be understood that it is far less difficult to sell some thousand shares of stock to a large number of buyers (under present existing circumstances in Germany) than to sell the machinery and plant of the stock company to one buyer. The profit by this kind of business is also larger, as the stockholder not only pays for the machinery, etc., but also for what the concern is worth, and he does not mind paying a larger amount, as the risk in a transaction of this nature seems to him considerably smaller. In this way all parties profit—the electrical firm, because it finds constant employment and receives good prices for its products; the bank, because it is well paid for the credit which it grants; the purchasers of the undertaking, because they receive a finished and secure enterprise, and finally the nation, because this effective form of business greatly facilitates the creation of useful enterprises.

Although the advantages which the method of business described undoubtedly possesses are many, it also just as certainly contains dangerous weak points.

Due to the good name of the electrical firms and the high standing of the banks working on this method, they are able to form enterprise after enterprise in rapid succession, as every successful flotation makes the public still more eager to purchase such shares.

Unless the combinations do not act under the strictest self-control, they will very easily be led to create unsound enterprises in order to profit by the sale of the shares. By this it is not meant to imply

that such evil consequences have already shown themselves, as on the contrary it is a fact that the financial and technical managers of the industry are endeavoring to preserve this high moral standing. However, the lack of moderation on the part of the general public must be taken into consideration, as the desire for paying investments of this nature has been awakened and new establishments are demanded by them in an increasing degree.

Should this demand not be satisfied by the large and reliable banks for fear of an over flotation, there are many less scrupulous financiers who would not hesitate to do so, so that the possibility of an excess of such companies is a real one, and it would behoove the financiers who now control the industry to exercise a certain amount of present self-sacrifice in order to avoid a grave reaction in the future.

The yearly savings of the German people, although increasing annually, are yet limited, and if this sum be very largely invested in any one industry, as is becoming the case with the electrical industry, other industries just as necessary to the welfare of the country must suffer from a lack of capital.

In conclusion it may be said that the present prosperity of the industry does not offset these dangers, and it would be well for those who control the industry to assume a wise moderation in time, which moderation would not in the least effect its natural and steady development.

CARL KAISER.

Berlin, January 15, 1900.

PERSONAL.

Professor Henry S. Carhart, of the department of physics of the University of Michigan, who has been spending the year in Germany, is now in Zurich studying the subject of electrical engineering with Professor Weber.

Lieutenant Paul Stockley, U. S. A., is reported as missing in a recent battle in the Philippines. Lieutenant Stockley is a son of Mr. George W. Stockley, formerly president of the Brush Electric Company, and now a resident of New York. It is the hope of Mr. Stockley and his friends that the lieutenant has only been captured and will soon be released.

Mr. C. O. Baker, Jr., the platinum magnate, of Newark, N. J., and New York city, has returned to his home haunts after a three months' absence on the Pacific coast and the Hawaiian islands. Mr. Baker, while in Honolulu, narrowly escaped being quarantined as a bubonic plague victim, but with his usual good fortune and *savoir faire,* he managed to get back to the United States in time to keep the engagements outlined in his prearranged schedule.

ELECTRIC LIGHTING

The Alliance, Ohio, Gas and Electric Company has elected these officers and directors for the ensuing year: L. W. Prior, president and treasurer, Cleveland; C. A. Emery, vice-president, Cleveland; W. H. Schott, secretary, Chicago; M. A. Devitt, Chicago; J. A. Wallace, Chicago; W. A. York, Cleveland; W. E. Emery, Cleveland.

A change in the ownership of the property of the Memphis, Tenn., Light and Power Company has taken place within the last few days. Captain W. W. Carnes, former president of the National Electric Light Association, has sold his interest in the light plant to Frank G. Jones, general manager of the Memphis Street Railway Company.

At its annual meeting, the Great Barrington, Mass., Electric Light Company elected officers as follows: President, D. Ward Northrop; vice-president, Parley A. Russell; directors: D. Ward Northrop, Parley A. Russell, Horace R. Butler, Charles J. Burget, Walter E. Lewis and Frank H. Wright; clerk, Frank H. Wright; treasurer, Charles J. Burget.

The Edison Electric Light Company, of Columbus, Ohio, has elected: President, Adolph Theobald; vice-president, J. F. Martin; treasurer, Emil Kiesewetter; secretary and general manager, A. W. Field. The Buckeye Malleable Iron and Coupler Company: President, treasurer and general manager, W. F. Hoodspeed; vice-president, Frank Rockefeller; secretary, Joseph Stafford.

The Superior Electric Light Company has made a proposition to purchase the mill and water-power on the Cottonwood River at the edge of the town of Cottonwood Falls, Kas., and erect an electric plant capable of running arc and incandescent lights and furnishing motive-power for the street railway. To provide against failure of water to operate the plant a steam engine and boiler will be put in.

At a meeting of the Clear Lake, Iowa, Electric Light and Power Company, it was decided to double the capacity of the plant. The power house will be rebuilt, a 150-horse-power boiler will be substituted for the 80-horse-power now in use, a 3,000-light dynamo will be put in in place of the old 1,000-light dynamo and other improvements will be made. The capital stock was increased from $10,000 to $20,000. J. L. Etzel is president of the company.

The electric light commissioners of Anderson, Ind., have contracted with F. Sargent, of Chicago, an electrical engineer, to prepare plans for the extensive enlargement of the electric light plant of this city. The present plant was purchased a few years ago from C. L. Henry, and the earnings have been so far more than met the maturing obligations. The City Council has voted an appropriation of $20,000 for the improvement of the plant. The commissioners announce their intention to give the public service at minimum cost.

Three new electric light companies have submitted ordinances to the City Councils of Reading, Pa., asking franchises to erect poles and string wires in the city limits. They are the Berks, the Neversink and the Metropolitan. The Electric Railway Equipment Company, of Cincinnati, has leased No. 5 mill of the Reading Iron Works, to manufacture iron tubular poles for trolley lines, etc. The firm has received an order for 2,000 poles to go to Havana, and for 1,500 for Berlin. Large orders have been completed for New Bedford, Fall River, Stonington, Albany and San Francisco. Poles are built from 28 to 50 feet high.

Just at this time the residents and taxpayers of Belair, Md., are interesting themselves in having the Board of Town Commissioners establish an all-night and every-night electric light service for the town. A committee, comprising a number of the leading citizens of the town, headed by John H. Reckord, recently appeared before the Commissioners in reference to the matter. Mr. Reckord, who now furnishes the electric lights for the town on a half-night system, made the Board three propositions, which will be submitted at a town meeting to be held shortly. The town pays $800 a year for 41 lights, on a moonlight schedule, which are turned off at one o'clock.

The Connecticut Lighting and Power Company, by Assistant General Manager Mather, and by W. T. Foley, acting for the borough of Southington, Ct., has signed a one year's contract with Southington for electric lighting in the borough beginning February 1, 1900. The company agrees to furnish 142 25-candle-power lamps and 30 30-candle-power for $3,000, lights to be burned on a moonlight schedule. The 30-candle-power lights are to burn till 12.30 A. M., and the others till midnight. The old contract expired November 1, 1899, owing to the disagreements among members of the board and the company. Light has been furnished under the old contract and will be thus furnished till the date of the new contract.

VIEWS, NEWS AND INTERVIEWS

In his report upon the disaster to General Gatacre's column at Stormberg, the London *Times* correspondent lays some stress upon the neglect of compass bearings being taken during the night march. Its correspondent at Cape Town, however, in forwarding the account, says he thinks this point has been exaggerated, and he makes the following observations founded on his own experience: Owing to the abundance of magnetic ironstone all over South Africa (and the name "Rooi-kop," "red-head," probably indicates its presence near Stormberg), compass bearings are liable to be all over the place, especially at night, when it is impossible to know how near one may be to magnetic rocks. At Chieveley one day I was taking some bearings which made Colenso lie due east instead of north, north for the nonce happening to be a large stone a yard or two away.

An automobile that cost when new $3,000, sold at auction recently in Paris for $13,200, after making a fast record. It appears that developed speed is valuable in machines as well as in horses.

The New York, New Haven & Hartford Railroad Company, it is reported, will install a large electric storage battery plant at the Union Station, in Hartford, Ct. It will be used as an auxiliary to the electric plant at Berlin for the operation of the third rail electric system to Bristol, and for the further extension of the system to Rockville, to accommodate the continual growth from the suburban towns east of Hartford.

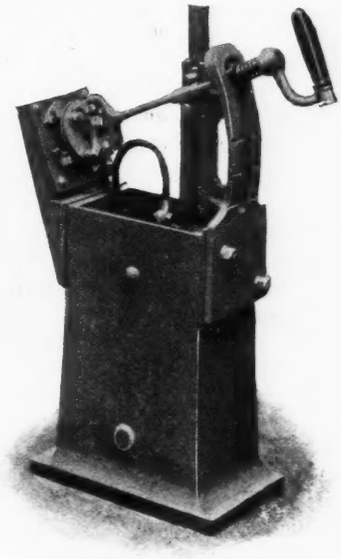
During 1899 articles of incorporation of electrical companies were filed in Michigan as follows: Street and electric railways, 18; telephone, 13; electric light, 8; gas, 7.

According to the specifications of the New York Rapid Transit Commissioners about $5,000,000 of electrical apparatus will be used in the construction of the tunnel on the basis of present prices. Before the road is in complete operation, however, expenditures for electrical apparatus will be from $12,000,000 to $13,000,000.

The annual meeting of the stockholders of the New York & New Jersey Telephone Company will be held at 81 Willoughby street, Brooklyn, N. Y., on March 2.

A Water Rheostat Motor Controller.

The design and construction of electric cranes is at present occupying much attention in England. Several firms in that country have produced excellent designs of motors and accessory parts for this use. The illustration herewith presented, taken from our London namesake, shows the controller of a series motor of 6.6 kilowatts capacity, made by Messrs. Thomas Parker, Ltd., and used with their standard crane motor. The controller is of the liquid resistance type, the electrodes being raised or lowered by a bar sliding in vertical guides and actuated by the handle bar. The latter is pivoted on a plate



A WATER RHEOSTAT CONTROLLER FOR A CRANE MOTOR.

at the back of the reversing switch which is also controlled by the same handle. A slot in which the handle bar travels is so shaped that the latter can only be turned so as to reverse the motor when the handle is at its highest position, and the electrodes withdrawn from the liquid. The curved slot plate is nicked at intervals so as to receive a spring catch on the handle, thus giving definite intervals of resistance. By this construction it is impossible to cut off the current without leaving all the resistance in circuit or to reverse the motor without first switching off, while the direction in which the handle points shows which way the motor will run. The whole machine is a very ingenious and well-designed piece of mechanism which reflects credit on its builders.

Professor Cauro, of the Paris School of Pharmacy, was recently killed while making experiments on Mont Blanc on the interruption of the electric current through ice.

A DECISION IN THE WASHINGTON TELEPHONE CASE.

ACT OF CONGRESS FIXING RATES DECLARED UNCONSTITUTIONAL.

Justice Barnard, in the Supreme Court of the District of Columbia, handed down a decision on February 5 in the case of James F. Manning and others against the Chesapeake & Potomac Telephone Company. This is a suit which has been occupying the attention of the court for the past two years, and the plaintiff was associated with about one hundred other telephone subscribers in the test case. Justice Barnard holds that the act of Congress approved January 30, 1898, fixing a maximum rental of $50 per year for the use of a telephone in the District of Columbia, is unconstitutional by reason of the fact that the rates fixed by Congress are unreasonable for the service and supplies furnished.

Justice Barnard's decision is an able and exhaustive statement of all the questions involved and is a complete victory for the company. The case turned upon the point set up and persistently urged by the opposition, that an increase in the number of the subscribers in a telephone exchange reduces the cost per subscriber, and that the Washington exchange can furnish unlimited service, with the most modern and efficient appliances, at $50 a year. In the attempt to prove this the testimony of a large number of the managers and employees of opposition companies was taken but, in the judgment of Judge Barnard, it utterly failed to substantiate the claim.

Thomas A. Edison Down With the Grippe.

A press dispatch from Akron, Ohio, dated February 5, says that Mr. Thomas A. Edison is confined to his bed in that city with an attack of acute influenza. He is staying at the home of his wife's parents and Mrs. Edison is attending him, although his illness is not considered serious.

Rumor of an Automobile Trust.

It was rumored in New York city last week that a movement was on foot to amalgamate all the automobile and bicycle interests in the United States in a $200,000,000 trust. While it was stated that Mr. Charles R. Flint was heavily interested in the scheme the rumor could not be confirmed.

The Electrical Equipment of the Union Traction Company, Philadelphia.

The city of Philadelphia, renowned in history since 1776 as the home of the Declaration of Independence, has since that period spread over a large district, having 1,500,000 inhabitants. The Union Traction Company controls the entire traction system, covering a space of about 23 miles by 16 miles, and having a length of 450 miles of railroad track in the city and its suburbs. It is the largest street railroad property in the world, the gross annual earnings being about $12,000,000.

The Union Traction Company is the result of the consolidation of 36 smaller street railway lines which covered the city of Philadelphia and suburbs. The consolidation necessitated several drastic changes in operating methods for simplifying the entire electrical system and introducing economy. A general description of the electrical system, as now operated, is of special interest in view of the magnitude of the enterprise.

The financial results of the consolidation have been very satisfactory. The system of centralization resulted in a reduction in operating expenses during the first year from 56.48 per cent to 49.27 per cent of the gross income. The service has been thoroughly maintained as shown in an increase of five per cent in the passengers carried, and of gross receipts. An annual deficit of $850,000 has been turned into a surplus by the increase of five per cent in gross receipts, coupled with a reduction of 10 per cent in operating expenses.

Some of the generating stations of the constituent companies were abandoned upon consolidation. The company now operates its lines from seven main power stations and three substations. The 10 stations have 38 generators, with an aggregate of 40,000 horse-power. The Westinghouse Electric and Manufacturing Company has supplied about half of the generators for this output, including the largest units. The seven main stations are connected together by special tie-lines of large capacity, so that under varying conditions of load they can be made to assist each other.

The thorough equipment of the Union Traction Company's system was demonstrated upon the occasion of the fire in 1897. The flames gutted the building in the evening, but by the following morning the 180 feeders at this station were all in circuit, power being supplied by the other stations, and no interference of the street railroad service occurred.

The main station at Thirteenth and Mt. Vernon streets presents many interesting features of the latest electrical practice in street railroad traction. The boiler equipment consists of 7,000 horse-power of water-tube boilers, with a working pressure of 150 pounds to the square inch, supplying steam for four compound steam engines operating at a speed of 80 revolutions per minute. The engines are directly connected to four 1,500-kilowatt direct-current engine type generators, giving 2,730 amperes and 550 volts. These generators have the largest capacity for direct current which had been constructed up to that time. The field yoke of the generator is divided vertically, and rests on a cast-iron base plate. The two halves of the field may be moved back from the armature to permit access to the armature and field winding. The field has 14 poles, built up of laminated steel and cast into the yoke. The yoke is of cast-iron and of very large cross-section for mechanical strength. At the pole tips the corners of half the laminations are cut away, leaving but half the pole section at the edges, but with full section at the centre. The proportions of the corners are such that the field distortion with load is comparatively small.

The series and shunt coils are separately wound and insulated, and have an air space between them when in position on the field. This construction gives the best possible ventilation and allows examination of the inner, as well as outer, surface in case of injury of any sort. The series coils are of copper bars wound on edge, with air spaces between the turns.

The armature is 128 inches in diameter, of the slotted drum type, with bar windings. It is multiple wound, with 14 circuits. The coils are made of copper strap, bent into exact shape, and insulated before being placed on the core. There are no joints in the coils. The armature winding is held in the slots by supporting wedges over the coils. At the rear end the shape of the coils is such that they fit together and become self-supporting, and thus do away with any supporting clamps or bands. The armature core is built up of high grade, specially annealed steel. No bolts are used in clamping the core and end plates. The commutators of these generators are very large, having a diameter at the wearing surface of 100 inches. The width is sufficient for eight brushes, with the standard Westinghouse holder.

A characteristic feature of the armatures of these machines is the balanced condition of the magnetic circuits. By special construction, the magnetic strengths of the different field poles are kept equal, independent of inequalities in the magnetic circuits. By this means, the multiple-wound armature is able to give equal electro-motive forces on all its 14 circuits under any conditions. A field coil may be short-circuited, or even reversed, and the machine will continue to operate well. The armature may be placed out of centre in the field, with practically no effect on the commutation. A direct result of this balancing of the pole strength is that, when the machine is running, there is practically no unbalanced magnetic pull between the armature and field when the armature is out of centre. The armature may touch the poles at one side, and there will be very little tendency to hug them.

The commutation of these generators is said to be very good, and there is no change in lead. The brushes may be set at no load, and the load may be increased to 5,000 amperes, with practically no sparking. With this load the circuit-breaker may be opened up, and there will be no flashing and the brushes will require no shifting. This result is due partly to the proportions of the field pole-tips and to the low self-induction of the armature coils under commutation.

In order to equalize the weight of the two main engine bearings, as well as to protect the commutator from any danger from oil, these machines are placed on the shaft the reverse of the common practice; that is, the commutator is next the fly-wheel. The armatures are accessible for cleaning, and are thoroughly ventilated. The heating is remarkably slight on these machines.

The total weight of one of these 1,500-kilowatt Westinghouse generators with field and armature complete, is about 208,220 pounds. The bed-plate measures 23 feet in length, and four feet seven inches in width.

The switchboard stands at the south end of the station, being made up of five generator panels, eight instrument and tie-line panels and 76 feeder panels. It is of the two-bank type, the gallery running from the lower bank and giving access to the upper. The connections are made of heavy copper bars fastened together in parallel, so as to furnish sufficient carrying capacity without the slightest overheating, in spite of the heavy currents passing from the different circuits.

There are two positive busbars on the generator and feeder panels. The feeders can be connected at will to either of these busbars, and all or any number of feeders can be served by the four generators in the Mt. Vernon street station; while in case the station becomes overloaded in the heavy hours of the day, current can be drawn through the tie-lines from one or more of the other four stations and

connected to special banks of feeders, whose loads are proportionate to the amount which can be spared from the sending station. Conversely, the Mt. Vernon street station can help out any of the other four stations at the time of their greatest load, sending current over the tie-line, this current being used on special feeders in the receiving station.

All the current in the company's different stations is carefully metered at various points, so that the company's records are exceptionally complete, and its costs are reliable.

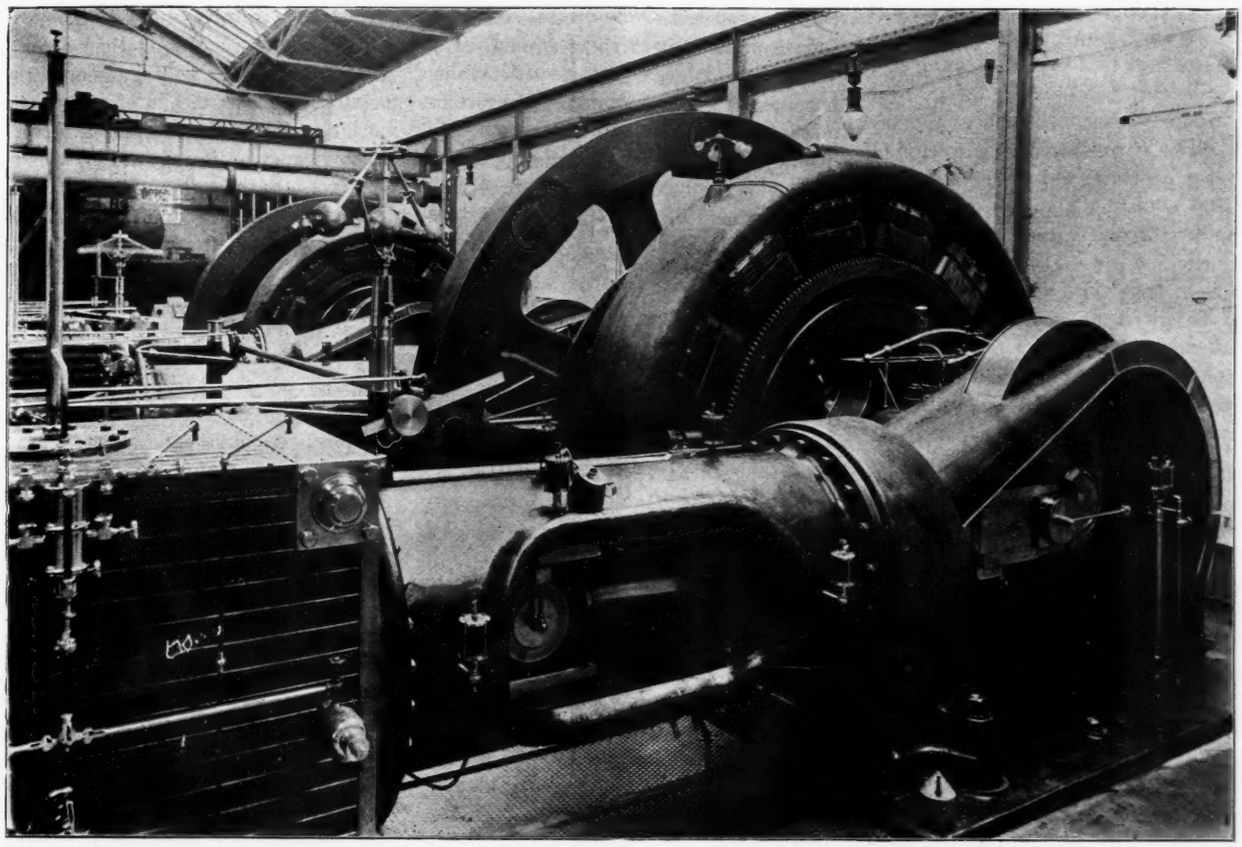
Westinghouse generators are used in the other main stations and substations of the Union Traction Company's system. At Thirty-third and Market streets are two 1,500-kilowatt direct-current generators, similar in construction to the four forming the equipment at Thirteenth and Mt. Vernon streets, the remaining equipment of this station being three 375-kilowatt direct-current generators. The station at Thirty-second and Dauphin streets is operated entirely by three 525-kilowatt direct-current generators. A similar machine operates the station at North Delaware avenue. The Wheel Pump station is operated by a 525-kilowatt direct-current generator. The Willow Grove substation has three 200-kilowatt direct-current generators belted to their respective engines, all the other machines being of the usual engine-type direct-connected to their respective engines.

It can be understood from the above description of the tie-lines and the Mt. Vernon street switchboard that the company's stations are not operated in parallel to serve the general distribution system. This has been found impracticable, not only because of the number of stations to be so connected, which would naturally introduce complications, but also because the stations are so near together that any practicable tie-line would be of extremely small resistance, and the point of zero difference of potential between the current output of the several stations could not be confined to the distribution circuit, but would inevitably work back into the stations themselves, and reverse the generators. The alternative plan has therefore been adopted of grouping feeders so that they can be served from any one of the stations—not alone that to which the feeders are directly connected. On account of the enormous area covered by the city of Philadelphia and by the company's lines, the load peaks of the different stations are not simultaneous, and it is possible for one station running below its maximum load to help out another which may be overcrowded. The Mt. Vernon street station, for example, being in the heart of the business district, naturally requires help during that hour in the afternoon when the rush of homeward travel begins, while a little later it may help out some outlying station whose cars are crowding in upon its feeders.

The Traction Company owns nearly 3,000 motor cars, the majority measuring 18 feet by 22 feet in length, equipped with single trucks, although there are a few double truck cars. The Westinghouse Electric and Manufacturing Company supplied the electric motors for a large proportion of the car equipment.

The efficiency of the motors is such that the current output of the station is equivalent to about 1.3 kilowatt-hours per car-mile operated in Summer months, and 1.5 kilowatt-hours per car-mile in Winter, when heaters are used.

The immense system of street railroads owned by the Union Traction Company, Philadelphia, demonstrates the advantages of consolidation of lessees' lines under one efficient head, and the adoption of the highest class of electrical machinery, and the substitution of large units for a number of smaller ones, all of which combined have transformed a nonpaying business into one of a remunerative character.



VIEW IN THE MOUNT VERNON STREET STATION OF THE UNION TRACTION COMPANY, PHILADELPHIA—SHOWING ENGINES AND DYNAMOS.

SCIENCE BREVITIES

Measuring the Heat of the Stars—A radiometer for measuring the heat radiation of the stars has been tested at the Yerkes Observatory. The instrument is the outcome of the work of Mr. E. F. Nichols, of Dartmouth College. It consisted of a suspension system formed of two mica disks, each two millimetres diameter, blackened on the face, and supported by a light cross arm on either side of a thin glass staff, hung by an exceedingly fine quartz fiber in a partial vacuum, says the *Scientific American.* Both vanes were exposed to the radiation of the sky at the focus of a silvered glass mirror of 24 inches aperture, fed with light by a siderostat outside. The rays entered the radiometer through a small window made of fluorite. With the apparatus so arranged, a deflection of 0.1 millimetre would be given by a candle 15 miles distant, neglecting loss by reflection and atmospheric absorption. The results obtained showed that stellar heat radiation was distinctly detectable.

Electricity in Agriculture – A British contemporary quotes from the *Eleckt. Zeits.* that an association of farmers in the district of Ochsenfurt (Bavaria) is erecting large electrical works near the village of Butthard, in Lower Franconia, which will be entirely devoted to agricultural uses. The current is produced close to the village of Schaftersheim, a distance of 11 kilometres, requiring for its creation a force of about 150 horse-power, which is supplied partly by steam and partly by water, and conducted as current of 5,000 volts to the villages of Butthard, Laudenbach and others, where it finds the most varied use. Movable electromotors for driving thrashing machines, chaff cutters, bruising mills, etc., are supplied, and connecting boards for the conducting wires are placed at every farm. The motors are of very simple construction, and can be easily handled by any of the farm hands. The electric light will be widely used in all the villages named, and on account of greater security with regard to fire in the lighting of agricultural buildings it is daily increasing in use among farmers.

Electricity in Mining – Some interesting details of an important method now being tried in Prussia for bringing down coal, was given in a recent number of *Kuhlow's Review.* Recently some experiments were made by the Clausthal mine inspectors with an electrically-driven percussion rock-drill supplied by the Union Elektricitats-Gesellschaft, of Berlin. They state that a practical opinion as to the practicability of the drill can not be obtained at present, as the machine in its present form is both too long and too heavy. The great length in certain cases prevents the holes being put in where they are wanted, while the excessive weight increases the loss of time in working. Some small defects are also complained of in the cable connectors. On the other hand, the Siemens and Halske electrically-driven percussion rock-drills have been used with success in the Olpe Arsberg mine district. With these drills, equipped with a one-horse-power motor running at 250 revolutions, holes can be sunk at the rate of 3½ inches per minute in the solid rock, and to about 4¾ inches in a mixture of rock and schist. With this drill the forward feed is effected automatically, being self-regulated, according to the hardness of the rock.

Resistance of Iron Wires—The abnormally large resistance offered by iron wires to alternating currents has been a matter of common observation for many years. It is due to what is called the "throttling effect," which prevents an alternating current from penetrating completely to the centre of the wire, and which is exaggerated in iron by its high permeability and the change of the latter with the current strength. The laws of this change are at present unknown, and Mr. E. Merritt has therefore instituted some experiments calculated to shed light upon them, says an *Electrician* abstract. In every case the ratio of the alternate-current resistance to the direct-current resistance of the same wire was determined. This ratio gave the throttling effect, and the method also eliminated any secondary effect due to heating. The results were in accordance with what might have been anticipated from the known properties of iron. For small currents the magnetization is small, and the behavior of the iron wire is not very different from that of non-magnetic metals. This throttling effect is largest where there is a maximum of permeability; but with still stronger currents the wire becomes magnetically saturated from the surface inwards, and when the core is saturated also the difference between the two types of resistance vanishes and the wire again behaves like an ordinary wire. The author's verification is, however, only qualitative as yet.

Diselectrification Due to Magnetism—A very interesting paper by Mr. C. E. S. Phillips, read before the Royal Society, is thus abstracted in the *Electrician:* The writer has found that, under certain conditions, an electrified body rapidly loses its charge when in the neighborhood of a magnetic field. Nor does it, so far, appear essential that there be any relative motion between the lines of magnetic force and the charged body itself.

Preliminary experiments have been made with apparatus consisting of a glass tube six inches long and one inch in diameter, at the centre of which there was cemented upon both the inner and outer surfaces a strip of tinfoil one inch wide. Suitable connections were then arranged for the purpose of charging either of these metallic layers by means of an electrical machine. The pole-pieces of a powerful electromagnet projected into each end of the glass tube through an air-tight flange, and in such a manner as to ensure the production of a strong magnetic field at the central portion of the tube. A Sprengel air pump was used to rarefy the gas within the tube, and in the first instance the inner coating of tinfoil was charged positively.

This charge gave rise to the well-known free positive and a bound negative charge upon the outer tinfoil coating, the presence of the former being indicated by the divergence of the leaves of an electroscope connected to that coating. While the pressure of the gas within the glass tube was varied over a range of from atmospheric pressure to that represented by 0.2 millimetre of mercury, the charge upon the inner coating being either positive or negative, showed no appreciable indication of being affected by the turning on or off of the magnet. But at pressures lower than 0.2 millimetre, and when the inner coating was positive, the sudden collapsing of the electroscope leaves pointed to the removal of the charge through the action of starting or stopping the magnetic flux. Although the effect was more powerful at the moment of making or breaking the magnetic circuit, it persisted in a modified degree as long as the magnetic field existed. No such effect was observed when the inner coating was negatively charged, nor was there any action even in the first case when the magnetic pole-pieces, projecting into the tube, were magnetized so as to be either both north or both south.

The leaves of the electroscope were then connected to one of the internal pole-pieces, and it was seen that if sufficient positive electricity were supplied to the inner coating while the magnet was excited it became rapidly withdrawn, and ultimately resided upon the pole-pieces themselves.

Mr. C. S. Bradley.

Mr. C. S. Bradley, whose portrait appears on this page, entered the electrical field in 1881 with the Edison Illuminating Company, of New York. The laying of the underground conductors of the 1st district was inspected and tested by him and the rapid completion of the work was largely due to his executive ability. As soon as the station and system was ready for starting he was placed in charge as electrical engineer, which position he held until 1883 when he started in laboratory work for himself at Yonkers.

During the time he was with the Edison Illuminating Company, Mr. Bradley invented a method of testing the insulation of the extensive multiple-arc system while it was in full operation. This system is a modification of a Wheatstone's bridge, using the dynamo electric machine in the place of the battery and varying the resistance of the branches artificially. This was very important at that stage of development as the whole art was new. Mr. Bradley's ingenuity suggested a bridge to indicate the voltage by having in two branches German silver wire, and in two other branches incandescent lamps with a sensative galvanometer, connected in so that as the voltage increased at the terminals of the bridge the lamp carbons would increase in temperature, and depending upon the fact that as the temperature of the carbon increased the resistance became less, thus producing a deflection in the galvanometer by any increase or decrease of voltage. When the bridge was once balanced for a certain electro-motive force, the galvanometer gave a deflection in one direction for low electro-motive force and in the other for high electro-motive force. The introduction of this instrument at that early day reduced the lamp breakage by a large percentage, and brought the inventor Mr. Edison's approbation. He experimented upon and developed the method now largely used in the reduction of aluminum. The idea involved in this invention was heating the electrolytic bath by the current which performed the electrolytic decomposition. A patent filed in 1883 was issued for this in 1891.

In 1885 Mr. Bradley, in connection with Mr. Francis B. Crocker, invented a process for the production of aluminum alloys, which they style "Electrical Heating and Chemical Decomposition," wherein the ore was mixed with carbon and current passed through the mass sufficient to produce a reaction.

Mr. Bradley experimented, about this same period, upon the production of electricity from coal, a description of which has appeared in the transactions of the American Institute of Electrical Engineers. From 1885 to 1887 he developed some of the principal multipolar windings that are now so extensively used on direct-current dynamo machinery. In 1887 what is generally understood to be the first multipolar machine in this country, was constructed in his laboratory at Yonkers, and tested by Professor Geyer at the Stevens Institute of Technology, and then in the Edison Machine Works, at Schenectady, where it attracted a great deal of attention. Another product of this laboratory was the rotary converter now so extensively used, a patent for which was granted to him in 1888.

MR. C. S. BRADLEY.

In 1887 and 1888 he was busily engaged in developing the multiphase system of distribution. At the Frankfort Exposition in Europe in 1881, Mr. Bradley was given credit for being one of the earliest in the field of multiphase transmission, and he was one of the first to realize the relationship of successive phases of current and electro-motive force for the production of a continuous torque in electric motors. These inventions led him to form business relations with the Fort Wayne Electric Company, and after spending two years at Fort Wayne his interests were transferred to the General Electric Company. His inventions enter largely in the large business now done by this company in the long-distance transmission of power.

In 1894 and 1895 Mr. Bradley was engaged in experimenting upon alternating motors to run upon single-phase circuits, and developed a combination of transformer and condenser for the production of multiphase currents from single-phase currents, which was described before the American Institute of Electrical Engineers. At this time there was developed the three-phase condenser, and an induction motor with variable condensers in the secondary and called a consonous motor on account of the secondary currents being so adjusted as to produce vibratory currents in accordance with the principles laid down by Dr. M. I. Pupin, of Columbia College.

In 1896 Mr. Bradley filed his application upon rotary electric furnaces, which was found to be in interferance with William Smith Horry, and, after a protracted interference in the Patent Office, the patent was granted to Mr. Bradley in the early part of 1898. This furnace is used exclusively by the Union Carbide Company, of Niagara Falls, for the production of carbide of calcium and they have about 75 in operation.

As an evidence of Mr. Bradley's industry it may be mentioned that 75 patents have been granted to him in the United States.

Electric Lighting in Greece.

United States Consul McGinley writes from Athens, Greece: A company has recently been formed in Athens known as the Greek Electrical Company, with a capital of 5,000,000 drachmas (about $600,000, at present rate of exchange). The founders are the Bank of Athens and the Societe Generale d'Enterprise. The object of the new organization is to undertake the electric lighting of Athens, Piræus, Patras, Syra and Kalamata. There are 50,000 shares, at 100 drachmas a share, but they are now selling at a premium, being quoted at 107 drachmas a share on the floor of the exchange of Athens. Bids can be addressed to the company direct or to G. A. Constantinides, 3 Corais street, Athens. I have not been able to learn when the company expects to start operations.

Mica Production in the United States.

The mica production in the United States during 1898 amounted to 129,520 pounds of sheet mica valued at $103,534, and 3,999 tons of scrap mica valued at $27,564, giving a total value for the product of $131,098. This is an increase of 46,850 pounds of sheet mica and 3,259 tons of scrap mica over the production of 1897. This also shows the production of sheet mica in 1898 to be greater than for any year since 1884.

Captain Denholm Fraser, R. E., is at present engaged in making the necessary arrangements for inaugurating a magnetic survey of India and Burma.

ELECTRO-MECHANICAL BATTLE ORDER TELEGRAPH.*

PROPOSED BY LIEUTENANT-COMMANDER SEATON SCHROEDER, U. S. N.

An instrument of the following description is installed at the sending and at each receiving station. They all work in unison, being actuated by the same current; and their functioning is not affected by moderate variations in the strength of the current, the sole office of the current being to excite an electro-magnet at each station.

A dial, *D*, of convenient size, marked in sectors, is made to revolve behind a screen, *S*, of corresponding size, in which a sector is cut away so that only one sector of the dial will be visible at a time. A battle order is marked upon each sector of the dial.

The revolution of the dial is accomplished by means of an electro-magnet, *M*, and a toothed wheel, *W*, rigidly connected with the dial and revolving upon the same shaft. The armature of the magnet is connected by a rod to a radial bar, *B*, which is loose upon the shaft of the toothed wheel but which engages the teeth by a spring pawl.

When the current is admitted to the magnet it causes the radial bar to pull the wheel through a portion of a revolution, enough to bring the next sector of the dial into view. The current being shut off, a spring pulls the armature up and the radial bar back into position ready to pull the wheel through another sector when the current shall be turned on again; so that each display requires one or more positive actions.

A strong spring catch, *C*, engaging the teeth holds the toothed wheel in each position successively to which it is brought, preventing it from turning back; as it presses on the back of the next tooth (which is struck with the same radius), this catch also acts as a friction brake and steadies the wheel and holds it from slipping too far forward. Furthermore, it will push the dial back the short excess of distance that the armature should carry it forward, such excess being required to allow for any dirt or foreign substance which might lodge on the pole or come between it and the armature.

The mechanism is the same for all the dials, both sending and receiving, unless the automatic stop (described later) is attached to the sending.

The number of battle orders can be made as great as desired by increasing the size of the dial; but it is suggested that eleven will be enough, besides one blank sector, all of which could be plainly marked on a disk 10 inches in diameter.

A simple way to interrupt the current is by pulsating with a push button in the conning tower, or other sending station. But in the excitement of battle the button might be nervously pushed the required number of times in too rapid succession to excite properly all the magnets, and some might act and others not. To prevent this, a make-and-break wheel or interrupter is introduced in the circuit, which is caused to revolve at a fairly uniform rate of speed by a clockwork on its rear face; this wheel is divided into any convenient even number of sectors, one-third of the surface of each sector being insulated, so that when the button is pushed or a switch turned on, as the wheel revolves the circuit will be closed and broken alternately once for each sector of the dial, thus displaying each in turn. When the desired order is displayed, the button or switch is released by the sender.

The number of sectors of the interrupter should bear such relation to the speed of the clock train as to produce the desired length of contact on each sector. This would best be determined by experiment; if it be one second for each sector, the maximum time that could be required for any order would be 12 seconds. It seems probable that a perfectly certain operation could be effected in half a second for each sector, but this would require inconveniently precise work in releasing the switch.

The break surface of each sector is half the size of the make surface, as the actual work to be done during the break is much less than during the make. The current enters by one contact, and, traversing the wheel, leaves by the other.

A switch which will remain turned on until changed is preferable to a push-button, which must be kept pressed all the time, for the reason that in the event of the operator being disabled or diverted while sending an order, the use of the push-button would result in telegraphing some wrong order which happened to be momentarily displayed at the instant of disablement; while with the switch the apparatus would keep on functioning indefinitely and no order would be trans-

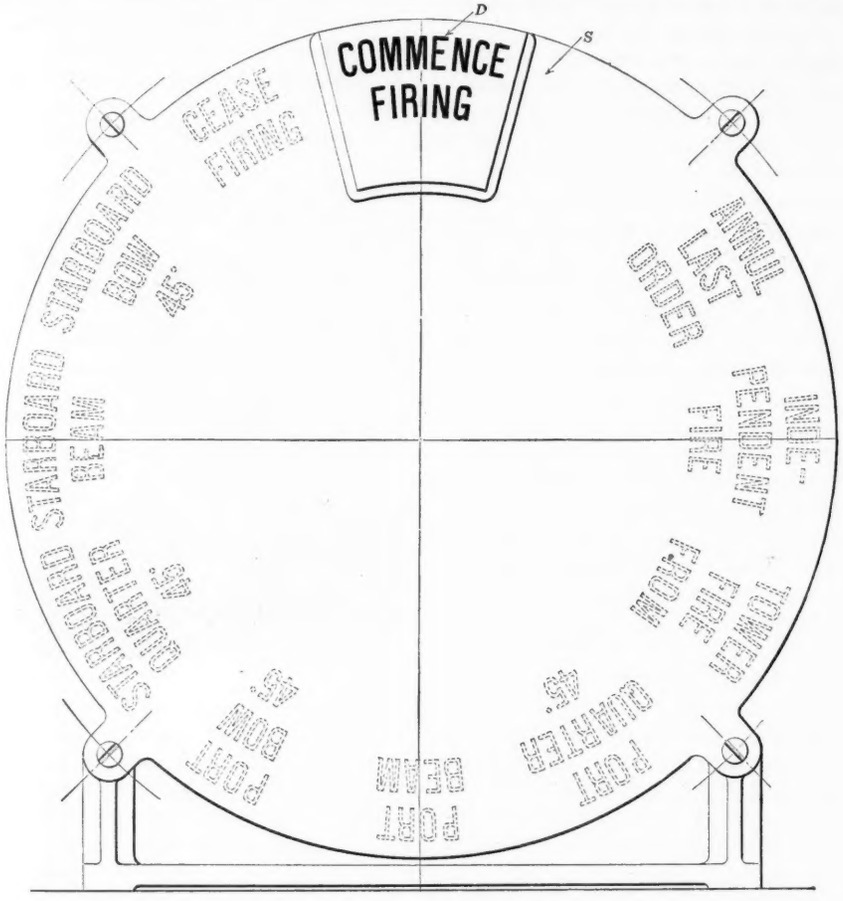


FIG. 1.—"ELECTRO-MECHANICAL BATTLE ORDER TELEGRAPH"—FRONT VIEW OF DIAL AND SCREEN.

* Republished by permission from the "Proceedings of The United States Naval Institute," Annapolis, Md.

mitted, which would be better than sending a wrong one.

All receiving stations and the sending station will be in the one circuit; and at each receiving station there will be a call-bell in the same circuit, which will ring whenever the circuit is closed, calling attention. At the sending station no call-bell is necessary, and there should be none, as the noise would interfere with telephone or other service. At the sending station, also, the dial should differ from the others in having small projections from each sector beyond the screen, upon which should be marked the nature of the corresponding battle orders, so that the sender could note as the desired order was approaching the display aperture and be ready to turn off the switch.

The clock train for the interrupter should be strong, with undetachable key, and designed to run only a few hours, so that at the end of the battle or test or exercise it would finally run down and not be needlessly worked. The fact of its not being wound upon any occasion would be immediately shown by the failure to operate, and the key being always in place it could be promptly wound. All working parts should be heavy and strong, and the magnets should have a vigorous reserve of power.

As the different stations are connected in multiple, an accident to one will not knock out all. It is recognized that when connected in this way there is no indication at the sending station that one of the stations is disabled; but that is not believed to be of equal importance to maintaining all the rest when one is disabled.

If the main should be shot away, the entire system would be paralyzed, as in the case of any mechanism; if the breakage occurred at the instant of sending an order a wrong one might be displayed, but the fact would be known at the sending station, as the same order would remain displayed there. This appears to be the only contingency in which a wrong order could be given, and it is a remote one.

The possibility is contemplated of having one main for the starboard battery and one for the port, with plugs to put in to connect either or both; but it is recognized that any such sub-division detracts just that much from the simplicity aimed at, and may not be of any utility.

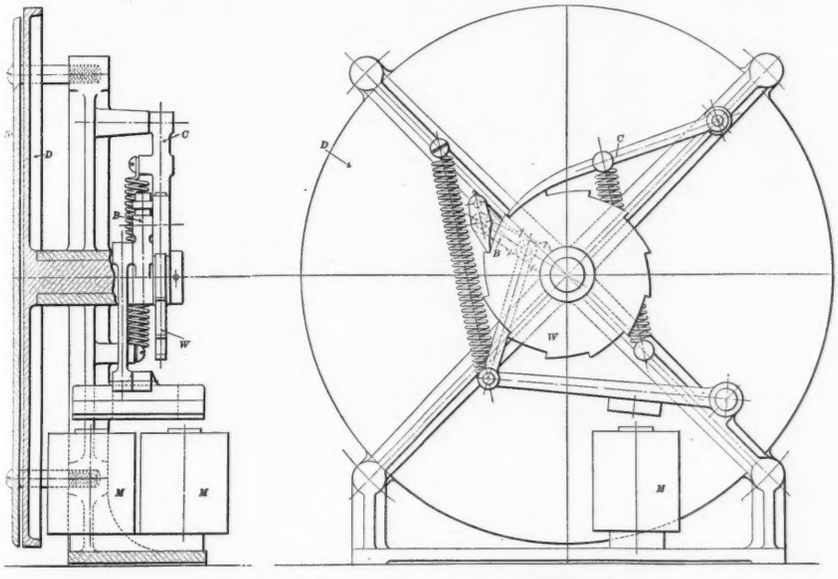
The general system is applicable for a range telegraph; it is suggested that the indications commence at 1,000 yards and extend in increments of 200 yards to 3,000. Within 1,000 yards a knowledge of the range is not necessary, and the action would also be too hot to attend to it; beyond 3,000 yards the range is not accurately obtainable. As decreasing ranges are apt to vary more rapidly than increasing, the maximum range should be the first in order of arrival at the display aperture, so as to require the minimum interval for telegraphing a decreasing range.

The system may also be applied to a steering telegraph. With several telegraph circuits installed on this system (battle order, range and steering), only one interrupter would be needed; and orders could be sent simultaneously through all the circuits, the only proviso being that the current be strong enough to properly excite the entire number of magnets.

As it may be objected that in time of battle the sender should not be called upon to watch the operation of the instrument, for possibly 12 seconds, in order to shut off when the desired order is displayed, an attachment is suggested for the sending instrument by means of which the sender needs only to put a plug into a socket in the periphery of the dial and then let it operate automatically. This, of course, adds to the amount of mechanism and detracts correspondingly from the simplicity, though not to a prohibitory extent.

Two insulated terminals are secured to the front face of the screen at the sending station. The right-hand one, *R*, constitutes a bracket for a small shaft, the upper end of which terminates in a bell-crank lever, *O*. The left end of the bell-crank presses against a stud or knife switch on the left terminal, *L*, being held in that position by a coiled spring, and completing the circuit. In the periphery of the dial there is a small socket bored in each sector; the shaft of the second bell-crank, *P*, may be plugged into any one of these sockets. An upper arm, *A*, is fashioned on the hub of the radial bar, which, during the reciprocating movements of the bar, moves back and forth through a small arc around the centre of the dial.

To stop the dial at any sector, plug the bell-crank, *P*, into the socket of that sector. When that sector reaches the display aperture the bell-cranks will have the relative positions shown in the drawing; the radial bar being released from the magnet and returning to its upper position, its upper arm, *A*, takes on the bell-crank, *P*, breaking the contact of the first



FIGS. 2 AND 3.—"ELECTRO-MECHANICAL BATTLE ORDER TELEGRAPH"—SIDE VIEW OF DIAL AND SCREEN AND REAR VIEW OF DIAL.

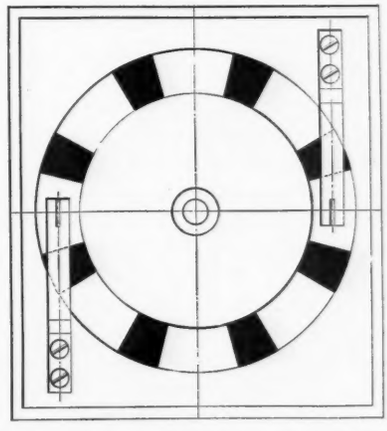


FIG. 4.—"ELECTRO-MECHANICAL BATTLE ORDER TELEGRAPH"—FRONT VIEW OF INTERRUPTER.

bell-crank, *O*, breaking the circuit, and stopping the entire system.

Wishing to send another order; take another bell-crank, *P*, plug it in where desired, and take out the one previously

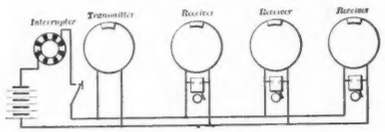


FIG. 5.—"ELECTRO-MECHANICAL BATTLE ORDER TELEGRAPH"—DIAGRAM OF CIRCUIT.

plugged in. The spring around the shaft of the first bell-crank, *O*, turns it back to the original position, closing the circuit again through the left terminal, and starting the system. Guide studs on either side of each socket, together with the peculiar elbow of the bell-crank, compel entering the bell-crank properly; the operation will be facilitated by remembering that the larger, round arm goes to the rear between the studs.

As indicated in the drawing, the arms of the frame and the lugs of the screen for a sending dial with automatic stop are longer than for an ordinary dial, in order to leave room for the bell-crank plug to pass through.

The wires indicated at the binding posts are drawn simply to illustrate the circuit. Insulated copper strips on the screen would preferably lead the current to and from the base of the instrument. For the purpose of this attachment, the entire current of the system must pass through the terminals on the screen. As the radial bar has more work to perform, the spring which returns it to the upper position must be strong, and also the magnet; though in all the instruments the reserve power should be more than enough for any such slight increase in weight.

With this attachment in use the speed of revolution of the dial may be much greater; because there is no doubt of the electricity doing its work fast enough, the only limitation being the ability of the sender to seize the right instant to shut off when the automatic stop is not used. This increase of speed would leave it expedient to increase the number of displays if desired.

In manufacture, no doubt a few changes will be found necessary in mechanical details. One instrument was ordered made for experiment at the New York Navy Yard, but it was found that the brass revolving dial-plate was too heavy, and the work was stopped. The substitution of a light tin dial would probably remove that difficulty.

It will be observed that with this instrument one signal is eclipsed before another can be made, so that no confusion or uncertainty can arise as to which was the last order.

Desirable orders other than those suggested in the drawing would include "use full charges," "use reduced charges," "use common shell," "use A. P. shell," "use Shrapnel;" while those given, such as "starboard bow," could be given a second meaning, as "watch for torpedo-boat on starboard bow," etc.

Wall Street and the Electrical Stock Market.

The market was favorably affected during the week by the industrials which reflected the action of the management of the American Steel and Wire Company in declaring an unexpectedly large dividend. It is evident that Wall street is emerging from a protracted state of despondency.

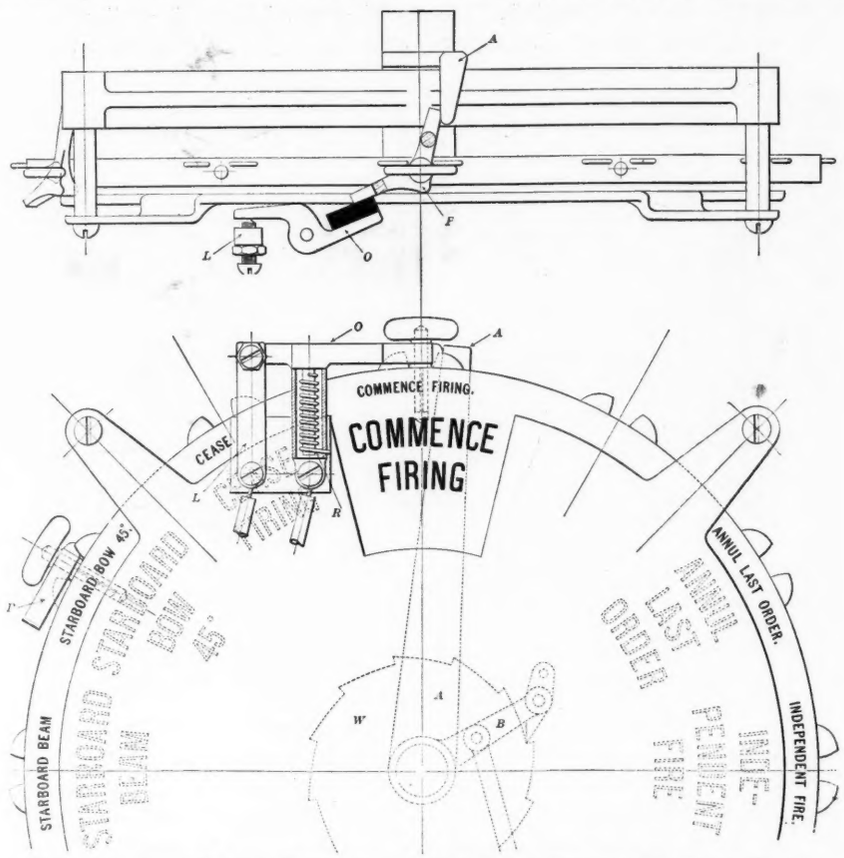
On the New York Stock Exchange, General Electric closed the week at 127¾ bid and 128 asked, an advance of 4½ points for the week. Metropolitan Street Railway, of New York, closed at 171½ bid and 172 asked, a gain of 2½ points for the week. Third Avenue Railroad, of New York, closed at 99⅜ bid and 99½ asked, a loss of 11 points for the week. The drop in this stock was apparently due to the uncertainty as to whether the company's floating debt of about $20,000,000 would be financed or not. It is understood that the action of the financial interests involved is delayed awaiting an inventory of the company's property. Brooklyn Rapid Transit closed at 75¼ bid and 75⅜ asked, a gain of 3⅞ points for the week. Manhattan Railroad, of New York, closed at 96⅛ bid and 96¼ asked, a gain of 2¾ points for the week.

On the Boston exchange, American Bell Telephone closed at 345 bid and 347 asked, a gain of 7 points for the week. Erie Telephone closed at 104 bid and 105 asked, a loss of 1 point for the week.

On the Philadelphia exchange, Electric Storage Battery closed at 81 bid and no asked price, a gain of 3 points in the bid price for the week. This company's business for the past year has been of the most satisfactory character, indicating a large increase in its gross output. Union Traction closed at 39⅛ bid and 39¼ asked, a gain of 1 point for the week. Electric Company of America closed at 12⅝ bid and 12¾ asked, a gain of ½ point for the week.

On the curb or outside market in New York, Electric Vehicle closed at 46 bid and 48 asked, a gain of 4 points for the week. Electric Boat closed at 18 bid and 20 asked, a gain of ⅞ of a point in the bid price for the week. Electric Axle closed at 4⅛ bid and 4½ asked, a gain of ½ point for the week.

Wall street, February 3.



FIGS. 7 AND 6.—"ELECTRO-MECHANICAL BATTLE ORDER TELEGRAPH"—DETAIL PLAN AND FRONT VIEW.

A Handsome Rubber-Covered Cable Exhibit for the Paris Exposition.

The accompanying illustration shows the exhibit of the Safety Insulated Wire and Cable Company, of New York city, for the Paris Exposition, which was shipped from New York on the U. S. S. Prairie, on February 1. The samples of "Safety" insulation shown are selected from the company's standard types as used for army and navy purposes, for electric power, and for the transmission of intelligence.

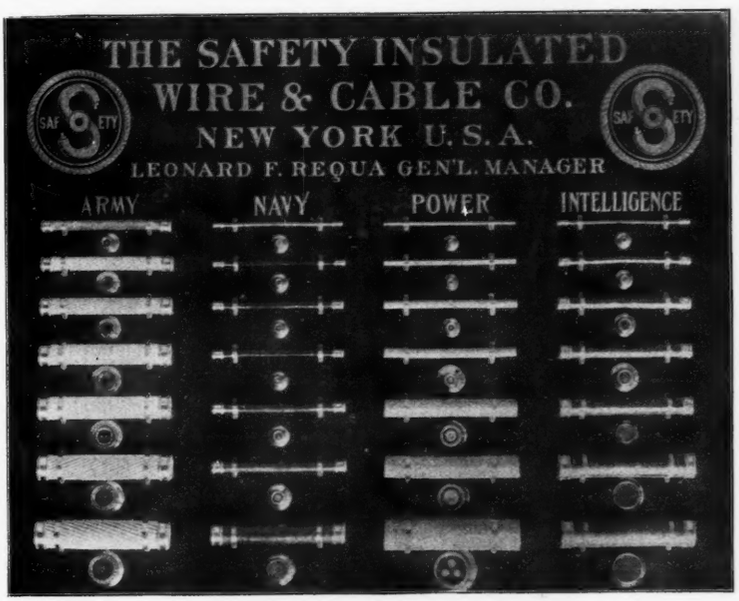
The army cables show the single-conductor deep-sea type as used in Cuba and for the connection of the different islands of the Philippine group. The multiple conductor cables are typical of those used for harbor defense, torpedo work, range finders, etc., the insulation in each case being rubber.

The navy wires exhibited are samples of those used in wiring the vessels of the navies of the United States, Russia and Japan. The small copper-armored cable at the top of the series shown in the engraving is a sample of that adopted by the United States Government for connecting a ship with the shore when at anchor, for counter-mining and for temporary and emergency work.

The power cables show examples of types used for the transmission of electric light and power currents in underground work. The insulations are designed for pressures ranging from 110 to 25,000 volts. A three-conductor cable, designed for three-phase railway transmission, is also shown.

The samples exhibited under the head of "Intelligence," are such as are used by the principal telephone and telegraph companies, showing single and twisted pairs for inside and outside work and also stranded and bunched cables.

The illustration herewith shows merely the back-board of the sample case which is formed of one piece of solid mahogany about two inches thick. A concave frame surrounds this back-board and when the exhibit is mounted at the Paris Exposition a glass front will protect the samples from curious sight-seers. The cabinet work as well as the design of the exhibit as a whole is very creditable.



A Cable Exhibit for the Paris Exposition.

Berlin Iron Bridge Company.

At the annual meeting of the stockholders of the Berlin Iron Bridge Company, held at the office of the company, in East Berlin, Ct., on January 29, the capital stock was increased to $750,000. The following board of directors was elected: Chas. M. Jarvis, Frank L. Wilcox, S. H. Wilcox, H. H. Peck, Geo. H. Sage, D. E. Bradley and Seymour N. Robinson.

A Westinghouse Dividend.

The Westinghouse Electric and Manufacturing Company has declared a quarterly dividend of one and one-quarter per cent on its common stock, payable February 20. Books close February 12 and reopen February 21.

National Carbon Company.

It is said that during the year ended January 31, the National Carbon Company earned seven per cent on the common stock, but no dividends on this stock are anticipated at present.

Removal of J. H. Bunnell & Company.

We are pleased to notice the continued prosperity of the old established electrical house of J. H. Bunnell & Company, the business of which has recently grown to such proportions as to make a change to more spacious quarters necessary.

The concern has leased the entire building at No. 20 Park Place where, with the increased facilities provided, the patrons of the house can rely on being more promptly and satisfactorily served than ever. The building has five floors besides the basement and sub-basement, and is equipped with freight and passenger elevators.

Mr. Charles McLaughlin, the surviving member of the old firm of J. H. Bunnell & Company, and who was the active business manager of it from the beginning, is at the head of the new concern, and is aided by the former corps of assistants in the various departments.

They will be pleased to have all their old friends and patrons call and see the new quarters which are now being fitted up, and the Electrical Review wishes them the success in the new location that was so deservedly theirs at the former house in Cortlandt street, New York.

Electric Storage Battery Company.

The Electric Storage Battery Company's sales for the year ended December 31, 1899, will amount to approximately $3,500,000, an increase of nearly 200 per cent over 1898, when the business was $1,300,000. The current business is averaging about $250,000 a quarter, or exceeding a rate of 6 per cent on the outstanding capital stock. The company has at present in banks $125,000; goods manufactured, but undelivered, $500,000; bills outstanding unpaid, but good, $750,000; total working capital, $1,375,000. The company owes nothing except small current bills, not exceeding altogether $60,000 and has no bonded or other indebtedness.

American Steel and Wire Company.

The directors of the American Steel and Wire Company last week declared a dividend of seven per cent on the common stock, payable in four quarterly instalments, beginning on April 2. It is stated that the net profits for 1899, after deducting a full year's dividend on the preferred stock, were equal to 13.72 per cent on the common stock. There is $40,000,000 of preferred and $50,000,000 of common stock. The payment of the seven per cent dividend on the entire capital, amounting to $6,300,000, leaves a surplus of $5,862,529.

An Automobile Attachment for Any Vehicle.

One of the difficulties that stands in the way of the general introduction of automobiles is the present investment in ordinary types of vehicles. The ingenious device shown in the accompanying illustration is designed to convert any ordinary vehicle, whether pleasure carriage, wagon or truck, into an automobile. It consists of a pair of wheels, upon which is mounted the motor equipment, and is designed to replace the forward wheels of the existing vehicle. For this reason it is called the "Forecarriage."

While adapted equally to steam or gasoline motors, the machine is also highly serviceable when equipped with electric power. The box, clearly shown in the illustration, contains the accumulator cells, and under it is placed the motor or motors.

A movable axle, which has the two-fold advantage and object of diminishing, as much as possible, the sliding motion necessary for the rotation of the axle, and of rendering the transmission of the motive force upon the axle independent of the various speeds of rotation of the wheel, and this without the use of the intermediate gear which it has been necessary to employ hitherto, is a feature of the machine.

A coupling mechanism, which effects the engagement of the several mechanisms from the driver's seat, notwithstanding their rotation during turning (as the latter operation is effected by the rotation of the forward section of the vehicle and the engine box as an entirety), is also included in the outfit.

The power equipment of these machines varies from four to 30 horse-power, according to the nature of the vehicles to which they are to be attached. A strong point in their favor claimed by the maker, the Automobile Forecarriage Company, New York, is that one machine will answer for delivery-wagon and pleasure carriage, thus giving its owner the benefit of a variety of automobiles with only one investment.

Adventures of Long-Distance Telephone Linemen.

A newspaper story from Michigamme, Mich., says that the work of stringing long-distance wires to connect the leading camps of the Michigan mining districts with New York, Boston and the principal western cities is being carried on during the Winter. The work was in such shape when snow fell that it could not be dropped until finished and all that was possible has been done to keep the men comfortable. The country from St. Ignace, on the northern shore of the Straits of Mackinac, up to Calumet, the big mining camp of the copper district which lies only four miles from the shore of Lake Superior, is a rugged one and the towns are few

AN AUTOMOBILE ATTACHMENT FOR ANY VEHICLE.

and far between, while farming is carried on only at a few points and at those in a desultory fashion. By reason of this condition it has been necessary for the telephone crews to live in tents while setting poles and stringing wires for the distance of 250 miles between the points named. Such a method of living was greatly enjoyed during the Summer, but when the first light snows began sifting down in September and the line was only half strung, not a few of the faint-hearted or calculating workmen had pressing business elsewhere. By dint of various persuasives, such as high wages, fancy "grub" and exceptionally decorous and cordial language the bosses of the many different crews succeeded in keeping their complements fairly filled and at present, in midwinter, there are nearly six hundred men in the various upper peninsula telephone gangs, all of whom are working in the open air 10 hours daily and sleeping under canvas, in temperatures ranging as low as 25 degrees below zero.

The men get high wages and every crew has a cook who could double discount the chef of the average small city hotel. There are blankets galore and chunky little box stoves which are stuffed with wood to the bursting point and kept at red heat all night long, notwithstanding which it remains cold inside the tent and none but a well-nourished and healthy man could stand such a life. Several large crews are now located near Michigamme, moving toward Houghton, which is 55 miles to the northwest.

As to the Trolley Car.

[*From the Reading, Pa., Herald.*]

The blessings of civilization are ever linked to its perils. Every new good thing has its sorry, solemn side. Even in Eden, Adam found there was a thorn for every rose. Many a modern cow has found a railroad track a thing of beauty first and an avenue of death subsequently. A new labor-saving machine is a joy to the manufacturer, but to the men thrown out of work it is a dark, dire curse.

FIG. 1.—AN ELECTROMOBILE BREAK.

And trolley cars—they're fine things when they get started, but they have their drawbacks. They have been introduced lately up the Macungie and Allentown way. These towns are getting metropolitanized. They walked erstwhile, as did all of us years ago. But the trolley

mania struck the region, likewise the trolley magnate. The gong sounded forth and the cars got going.

The natives jumped aboard in a delirium of joy. The novelty was fine. They handed over their nickels rapturously. The trolley was the gayest thing on earth, till they had gone a mile or two, and then they grew ill. One after another was overcome with seasickness. The Macungie *Progress* tells of it. "The sharp curves of the road and the dips and dives of the cars," all so strange and unusual, were the cause of it. "Last Sunday," it relates, "not less than six females from Allentown got sick on one car."

The hilarity of the riders is thus rudely tempered. Their gayety over the advance of civilization is brought up with a sharp turn. Rather, they're led to think, would they go back to the sedate footpaths of old than suddenly be converted into whirling dervishes. If it lasts much longer the Allentown-Macungie folk may feel impelled to turn their trolley cars into plowshares and their wires into pruning hooks, and go back to the peacefulness of the forest primeval.

But we would advise them to toil on and hope for better things. We all get used to excitement by and by. Four-story buildings used to make us giddy. But now we can gaze from the roof of a 29-story structure without a qualm. So may it even be in Macungie and Allentown.

Hope on, little brothers. Be patient and enduring. The nausea will not last forever. Just wait till you are used to the trolley car racket, and you'll decide that it's one of the best things out.

The report of the Boston Transit Commission gives the cost of the completed subway as $4,200,000. The number of passengers handled last year is given as 27,400,000.

FIG. 2.—AN ELECTROMOBILE MAIL PHAETON.

American Electric Vehicles at the New York Bicycle-Automobile Show.

The three illustrations herewith represent types of electromobile vehicles exhibited by the American Electric Vehicle Company, of New York, at the Bicycle-Automobile Show recently held in New York. Fig. 1 represents a "break," or four-seated trap, designed purely for pleasure purposes and capable of a fairly high speed. Fig. 2 shows a mail phaeton with seats for two passengers. Fig. 3 shows a delivery wagon for the carriage of goods of average weight. In all these vehicles certain features of the electrical equipment are similar. The running limit on a single charge varies from 30 to 50 miles, according to the condition and grades of the roadway, while the cost of running in all of them is claimed to be about one cent per mile where current is bought at the usual standard rates from electric lighting companies. A single motor equipment is used on all the vehicles, the motor being of a dust and waterproof enclosed type, having a hollow armature shaft and a single reduction gear between it and the driving wheels. In all the vehicles band brakes operated by foot levers are used, while the direct system of steering with a handle moving a horizontal plane is adopted as being both simplest and most efficacious. The reverse lever is very small, and a single turn of it reverses the motion of the carriage. This lever is also a safety device and is removable. When the driver descends from the carriage, by simply putting the lever in his pocket he renders the vehicle "foolproof" to the extent that it is impossible to operate it unless this particular lever is returned to its place.

A new feature of the American Company's delivery wagons is the use of illumined electric signs on them which are at once appreciated by every merchant or manufacturer using this class of vehicle. The finish and coloring of the vehicles is a matter to which their manufacturer has given much attention, the electromobile break illustrated in Fig. 1 still being regarded by many as one of the handsomest vehicles, both in finish and design, that has yet appeared upon the streets of New York city. As was mentioned in a recent issue of the ELECTRICAL REVIEW, the American Electric Vehicle Company has lately removed its offices and repository to New York city, while a large factory has been secured in a nearby town in New Jersey where unusual facilities for manufacture are at hand.

FIG. 3.—AN ELECTROMOBILE DELIVERY WAGON.

TELEPHONE AND TELEGRAPH

The Minnesota Telephone Company, with headquarters at North Branch, Minn., is negotiating with the Mutual Telephone Company for the purchase of the latter system.

The Little Wolf Telephone Company has declared an annual dividend of 10 per cent. It is not likely that the company will remove its headquarters from Weyauwega to Fond du Lac, Wis.

The Michigan Bell Telephone Company has closed a deal whereby the Detroit Telephone Company and Independent State Telephone Company became consolidated with the Michigan Company. The companies merged into the Bell have 6,000 miles of independent lines and control 10,000 subscribers in 46 cities of Michigan.

The Erie telephone system is now said to be the largest in America, and, with one exception—Great Britain—the largest in the world. It controls the companies operating under the Bell patents in North Dakota, South Dakota, Minnesota, Wisconsin, Michigan, Arkansas, Texas and in Cleveland. The combined capital of its companies is $22,000,000.

Following are the newly elected officers of the Mutual Telephone Company, of Des Moines, Iowa: President, D. F. Witter; vice-president, H. E. Teachout; treasurer, J. D. Whisenand; secretary and general manager, H. B. Wyman; W. L. Shepard, F. M. Hubbell, J. D. Whisenand, H. E. Teachout as executive committee acting with the president.

The United States Telephone Company has filed a five per cent gold bond mortgage for $1,000,000 in favor of the Cleveland Trust Company in the county recorder's office, at Mansfield, Ohio. The original mortgage was filed in Cuyahoga County. The mortgage covers 17 separate telephone lines in Ohio and the bonds are 10,000 in number at $100 each.

Through purchase of a majority of stock of both companies, the Michigan Telephone Company has closed a deal for control of two independent companies, the Detroit Telephone Company and the New State Telephone Company. The Michigan Telephone Company, which thus has regained control of what was its exclusive field, is one of the factors of the Erie Telegraph and Telephone Company consolidation.

The Knickerbocker Telegraph and Telephone Company has sent out a number of canvassers to obtain contracts for the service of that company in New York city. The contracts read that unlimited service in the boroughs of Manhattan and the Bronx shall be furnished for $60 a year, and unlimited service for the five boroughs for $120. The contracts do not become operative until 5,000 subscribers have been connected with the exchange.

The annual meeting of the Northeastern Telephone Company was held at Rush City recently. The following officers were elected: A. J. Stowe, president, Rush City; P. M. Peterson, vice-president, Stanchfield; S. A. Nebel, secretary, Danewood; J. C. Carlson, Rush City. The board of directors is composed of all the officers excepting treasurer, and including C. F. Jackson, Rush City. The company intends extending its lines to adjoining towns early in the Spring and will make other improvements.

Work has been commenced on a new telephone exchange building to be located on Dickson avenue, near Green Ridge street, Scranton, Pa. The building is to be completed by March 1, and will be 17 by 30 feet in size and one and one-half stories high. A complete new switchboard will be installed, and the present Green Ridge exchange will be moved into the new structure when completed. The new building is designed to give a better telephone service than heretofore to Green Ridge and North Scranton patrons.

The Southwestern Telephone Company has been incorporated in Santa Fe, N. M. Its capital is $25,000, and it will this year build 250 miles of long distance telephone line from Santa Fe to Las Vegas, to East Las Vegas, to Raton, to Elizabethtown, to Taos and to Tres Piedras. Branch lines to various mining camps will also be built. The officers of the company are A. A. Newbury, late of New York, now of Santa Fe, president; Oliver B. Steen, late of Taos, now of Santa Fe, secretary; and W. N. Townsend, of Santa Fe, manager. The company has already commenced felling poles for the line, the first stretch of which, to Las Vegas, will be commenced this month and finished by May.

A Query for Telephone Manufacturers to Answer.

To the Editor of Electrical Review:

Will you kindly let me know how multiple telephones stand at present in regard to infringement of patents? Are there suits pending involving the principle on which they are constructed? I am seeking information, not being posted on such matters. President.

Virginia, January 28.

Montauk Multiphase Cable Company.

The Montauk Multiphase Cable Company, 100 Broadway, New York city, makes the following statement to the Electrical Review through Vice-President Charles W. Price: "On January 22, 1900, an equitable working agreement was entered into, whereby an auxiliary company, now being organized, secures the privilege of representing the Montauk Multiphase Cable Company as sole selling agent in a field covering one-twelfth of their territory.

"Under this arrangement, the parent company receives for the franchise and royalties granted, a satisfactory cash remuneration and becomes locally interested therein.

"The parties who have secured this valuable license for this initial territory are successful business men and recognized authorities in the electrical field.

"The Montauk Multiphase Cable Company has several other negotiations of a like character in process of completion, and its business future as well as that of its licensees, under these conditions, presents a phase eminently satisfactory."

An Advertising Experience.

Colonel George Merritt, of New York city, who is largely responsible for the world-wide fame of the Waterbury watch, recently said to a *Printer's Ink* reporter:

"Many business men are deterred from advertising by the expense, but if done intelligently it is the cheapest thing in the store, so to speak. My experience in advertising the Waterbury proved this. I would not like to say how many thousands of dollars we spent in advertising, but I do not hesitate to say that for every dollar we spent we got twenty back. Business would flow in from the most unexpected quarters, and where we took the time to investigate we could always trace it direct to some of our advertising. In one case I did some advertising in London which attracted the attention of a representative of one of the largest jewelry firms in Japan, who was then in England, and as a result we received one order for 100,000 watches. Not only that, but 'Waterburys' were so much in vogue then and the Japs were so anxious for them, that a check for $150,000 accompanied the order."

Niagara Power Development.

The Commissioners of Victoria Park, Niagara Falls, Ont., have granted to the Exploration Company, of London, a concession to build a power canal on the Canadian side, from which 200,000 horsepower will be developed.

THE ELECTRIC FISH OF THE NILE.*

BY FRANCIS GOTSCH.

The lecture dealt almost exclusively with the formidable fish found in the rivers of North and West Africa, *Malapterurus electricus*.

Photographs were shown of the drawings upon the interior of the tomb of Ti, showing that the fish was recognized as remarkable by the Egyptians five thousand years before the Christian area. Living specimens of the fish were also displayed, these having been given to the lecturer, for the purpose of illustrating the lecture, by the authorities of the Liverpool Corporation Museum.

The structure of the electrical organ was then described. It is situated in the skin enclosing the whole body of the fish, and has a beautiful and characteristic appearance when seen in microscopic sections. Each organ consists of rows of compartments, and each compartment has slung athwart it a peculiar protoplasmic disk shaped like a peltate leaf, with a projecting stalk on its caudal side. Nerves enter each compartment, and end, according to the recent work of Ballowitz, in the stalk of each disk. By these nerves nervous impulses can reach the organ; the arrival of such impulses at the nerve terminations evokes a state of activity which is associated with the development of electro-motive charges of considerable intensity constituting the organ shock. The shock is an intense current traversing the whole organ from head to tail and returning through the surroundings; it stuns small fish in the neighborhood and can be felt by man when the hand is placed near the fish, as a smart shock reaching up the arms to the shoulders.

Recent investigations made by the lecturer at Oxford in conjunction with Mr. G. J. Burch were next described. These comprised a large series of photographic records of the displacement of the mercury of a capillary electrometer in consequence of the electrical disturbance in the organ which is "the organ shock." A number of these records were exhibited; they showed the time relations, mode of commencement and manner of subsidence of the shock, and demonstrated its similarity to the electrical changes known to exist in nervous tissue during the passage of a nervous impulse. A remarkable feature of the organ shock as distinct from the phenomena of nerve was then brought forward. The shock even when evoked by a single stimulus was shown to be rarely, if ever, a single one. Each effect consists of a rhythmical series of electrical changes occurring one after another in a perfectly regular manner at intervals of $\frac{1}{100}''$ to $\frac{1}{300}''$, the rate depending upon the temperature. By special experiments it was shown that this rhythmical series is due to self-excitation, each change producing an electrical current of sufficient intensity to excite the nerves of the tissue in which it was generated. It follows that only the initial member of the series need be evoked by nervous impulses descending the nerves, since the others must then ensue. The potency of the organ as a weapon to be wielded by the fish is thus enormously increased by its resemblance to a self-loading and self-discharging automatic gun. The total electro-motive force of the whole organ in a fish only eight inches long can reach the surprising maximum of 200 volts, at any rate in the case of the initial shock. The attainment of this maximum is due to the simultaneous development of perfectly similar electro-motive changes in each of the 2,000,000 disks of which the organ is composed. In a single disk the maximal electro-motive force only amounts to from .04 to .05 volt, and since in a small nerve an electrical change of .03 to .04 volt has been observed, the large total effect is not due to any extraordinarily intense electrical disturbance in each tissue element, but to the tissue elements being so arranged that the effect in one augments those simultaneously produced in its neighbors.

Finally, the remarkable characters of the nervous connections of the organ were described. Each lateral half of the organ, although it has a million plates receiving nerve branches, is innervated by one single nerve fiber and this is the offshoot of a single giant nerve-cell situated at the cephalic end of the spinal cord. The structure of this nerve-cell was displayed by means of microscopic sections and by wax models made by G. Mann, of Oxford. As regards the nervous impulses which the fish can discharge through this nerve-cell, experimental results were described which show that the fish is incapable of sending a second nervous impulse after a preceding one until a period of one-tenth second has elapsed, and that this interval is rapidly lengthened by fatigue to as much as several seconds. The inability of the central nervous system to repeat the activity of the organ obviously presents disadvantages to the use of the shock as a weapon for attack or defense, but such disadvantage is more than counterbalanced by the property of the organ alluded to in the earlier part of the lecture, viz., that of self-excitation, since a whole series of shocks continue to occur automatically in rapid succession provided that an initial one has been started by the arrival of the organ of a nervous impulse sent out from the central nerve-cell.

* Abstract of a lecture before the Royal Institution of Great Britain. From *Science*.

Damages for Injury Due to Defective Insulation.

The Rhode Island Supreme Court recently rendered a decision in favor of James Moran in his suit against the Corliss Steam Engine Company, says the *American Machinist*. The suit was brought to recover damages for personal injuries received by coming in contact with a defectively insulated crane operated by an electric motor, and resulted from the alleged negligence of the Corliss Steam Engine Company. The testimony showed that the crane at which the accident occurred was defectively constructed, either in that there was a metallic connection between the hauling chain and the motor, or that the insulation between them was not sufficient to prevent a leakage of electricity from the motor to the chain, and that though the leakage of electricity was probably insufficient to be dangerous, with no greater current than that designed to be used to operate the crane, yet it was liable to become dangerous from the presence of a more powerful current. At the time of the accident the wind was blowing at the rate of 40 miles an hour, with puffs at the rate of 60 miles. In the Court's opinion the jury would have been warranted in finding that the accident was due to the contact, outside of the defendant's premises, between the wire supplying electricity to the motor of the crane and some more heavily charged wire, whereby, by reason of defective insulation, possibly occasioned by the rubbing together of the wires, an unusually strong current was transmitted over the wire to the crane, and thence, by reason of the faulty construction of the crane, to the hauling chain.

The Court, in deciding the case for the plaintiff, said: "In view of the subtle and dangerous nature of electricity, the defendent making use of it was bound to exercise a very high degree of care for the protection of its employees against injury from such use. The accidental crossing or contact of wires caused by their sagging or breaking, or by high winds and other causes, and the consequent charging of the wires carrying the light current with a dangerous current from a more heavily charged wire, is, in our opinion, of sufficiently frequent occurrence to have suggested to the defendant the liability of accident from that cause, and to have required it to take precautions against injury to its employees thereby."

BRITISH NOTES.

(From our special Correspondent.)

I was going to begin my letter by congratulating you upon having entered a new century, but even about such a seemingly obvious matter as that there appears to be considerable question:

"Who shall decide when Doctors disagree,
And soundest casuists doubt, like you and me?"

I need not pursue the matter further, for in this country, at all events, one tackles this subject at the risk of life, and I dare say in your own Wild West, also, the rash man who does so might be laid out neatly and expeditiously; indeed to make references to the new century over here is nearly as dangerous as the youthful subaltern found it on a grilling morning in the hot weather in India, who ventured to congratulate his colonel and brother officers upon another bright sunshiny day. He, too, died suddenly—very suddenly—so that instead of discussing this thorny question I will take the liberty of wishing you and your readers, on my own behalf, a very happy and prosperous New Year, in which ever century it may fall.

In writing to you, of course, I should theoretically confine myself to electrical topics; but the topic of the moment here is emphatically the war, which overshadows everything else. Even that, however, I can "lug in by the heels," as they say, by observing that our British authorities, not having had the forethought to provide in time a wireless telegraphy apparatus, have done the next best thing in annexing one or two sets which were sent out for the benefit of our brother Boers; and it is said that they have been got to work with great success. There must be a satisfaction in the using of apparatus which has been procured by this time-honored method—

"—the good old rule, the simple plan,
That they should take who have the power,
And they should keep who can . . ."

Stolen articles, it has been said by the unregenerate, are always the most pleasant; and the brute creation gives us an excellent example of this in every right-minded dog, who enjoys the bone gained by illicit means far more than that which he has gained in the honest exercise of his profession. Reverting, however, to electricity, I may mention that *The Times* has just printed some excellent extracts from letters of a royal engineer officer at the front, descriptive of the difficulties of the Telegraph Battalion on service. You will see it quoted at some length in *Electricity* (London), so I need not enlarge upon it further here, except to remark upon the zest with which a man must necessarily perform his duties under the stimulus of such excitements. I suppose your people had plenty of experience in this kind of thing in Cuba, and I know from your columns that they are not being allowed to forget what it means in the Philippines.

At home, as an eminent electrician remarked to me to-day, there is plenty doing, but very little to remark upon. It is the old story, everybody is full of work, enough indeed to last them for months and even years, and there are no new developments. In Glasgow, as you will have heard already, a big contract has gone to an American firm, which has far outdistanced English firms in their offer. The details of this matter have not yet been made public, and it is difficult at present to understand how there came to be such an enormous discrepancy in the tenders. The fact, however, is so; and I am sure you will pardon us if we feel it to be unpalatable. Other minor excitements are supplied by what the press is pleased to call, "Electrical Explosions," which, of course, are really due to gas intruding where it has no business and getting set alight, and expelled vigorously accordingly. But the British public is slow to hear anything against an old friend, and as such it has already come to regard gas. It is said that the Prince of Wales has replaced the electric light by gas at Sandringham; I do not know whether this is really the case, but if it is so I must observe, even at the risk of my loyalty as a British subject being called into question, that it is no credit to his Royal Highness's judgment. Of course the gas people are very busy "chortling" over the circumstance, though their gayety was a little damped a week or two ago by a serious explosion at some large gas works, which killed the manager and some other persons. I do not allude to this in any spirit of levity, but simply to note the dangers which attend the use of this highly explosive agent as an illuminant.

I think I mentioned to you a few weeks ago (or if I did not I should have done so) the trouble about the electric light in Marylebone, one of our most popular suburbs. The truth is that the demand for electric lighting has grown in this country at a much greater pace than was ever expected, having regard to the conservatism of the British public. Most of the great lighting stations have been enlarged, sometimes twice and three times, but the demand continues to exceed the supply, and those responsible for their management are consequently attempting to undertake more work than they can properly keep up with. This has been the case with the Metropolitan Electric Supply Company, at Marylebone; they have gaily taken on every order as it came, and are now in the position of having more work than they can do. Additional plant has been ordered, but this, for various reasons, has not come up to date, and another excuse is found in the enormous demand for coal made by the government, which really has rendered it difficult for manufacturers to get sufficient coal of good quality for their requirements. When you add to this, the inefficiency of our railway companies which has made it almost impossible to transport with any reasonable degree of speed the coal supplies, for which we are depending upon the north of England, you will see that the electric lighting companies of the metropolis really have some difficulties to contend with, which ought never to have occurred. I see from the papers that as many as 300 trucks are lying useless at some of the great railway sidings, unable from the general block and mismanagement to go to the collieries to be loaded, or to London to be unloaded. This is not a creditable state of things, but, as they say, "Issachar is a patient ass," and the Britisher up to a certain point is the most "patient ass" in all creation. Then he is apt to get indignant and hammer the wrong person.

Do you do much in America in the way of utilizing dust destructors? I do not remember to have seen many references to them in your papers, but over here they are rapidly coming into favor —I mean for generating heat to be turned to account for raising electrical energy, or other purposes. The installation at Shoreditch, which was the first (or one of the very first) in which this system was tried on a large scale, has been a conspicuous success, and is now getting many imitators. A very good paper on the subject was read by Mr. W. Bamford, at Glasgow, in last September, and has just been published; I may commend it to your notice.

London, January 20.

Owing to the prevalence of flirting between passengers and guards on the Metropolitan West Side Elevated Railroad, in Chicago, a general order has been issued by the company forbidding guards to flirt on pain of discharge. The order has created consternation among employees of the road, and many amusing situations have resulted.

OUR CANADIAN LETTER.

PERTH, ONT.—The need of an electric fire-alarm system is being agitated.

BRACEBRIDGE, ONT.—It is likely that a by-law will be submitted to the ratepayers to raise funds for an electric light plant.

PEMBROKE, ONT.—The by-law to borrow $30,000 to install a municipal electric plant has been carried by the ratepayers.

FREDERICKTON, N. B.—The New Brunswick Telephone Company has decided to build a line from this place to Chatham.

DARTMOUTH, N. S.—The question of lighting the streets is under consideration by the Council; the present contract expiring in June.

TORONTO JUNCTION, ONT.—The Mayor in his inaugural address advocates the discontinuance of the incandescent electric lights and their replacement by arc lights.

NEWCASTLE, N. B.—J. C. Brown, of Richibucto, was here recently in connection with the project of building a railway from this place to the pulp mill near Chatham.

PHOENIX, B. C.—Mr. Duncan McIntosh has returned from Montreal, where he interviewed capitalists regarding the electric railway and electric light project here.

TORONTO JUNCTION, ONT.—The Town Council is at present considering the advisability of increasing the electric light plant for the purpose of supplying commercial lighting.

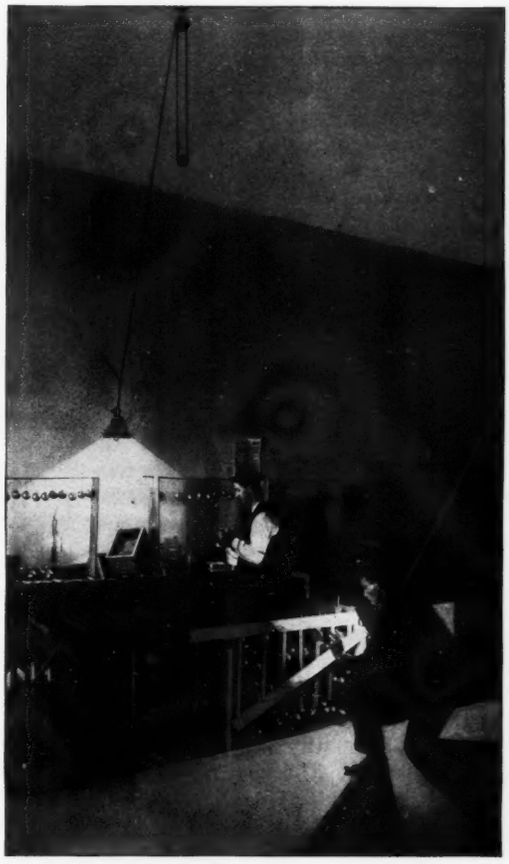
WINDSOR MILLS, QUE.—The by-law to raise $25,000 for a system of waterworks was carried by the ratepayers. The next step will be in the direction of securing electric lighting

ST. GEORGES, N. B.—The Pennfield & St. George Telephone Company held their first meeting at Beaver Harbor on the 7th inst., at which it was decided to build the line to Pennfield Station this Winter, and the extension to Lepreaux and Bay Bay in the Spring. S. L. Dakin is president of the company.

WEYMOUTH BRIDGE, N. S.—The Sissiboo Pulp and Paper Company, Ltd., are now getting out timber for a dam and are arranging for survey for the proposed electric railway. It is not expected, however, that the work of construction will be commenced before the first of March next.

HULL, QUE.—Mr Farley, city engineer, is at present preparing plans for a new electric light power house to be built on Brewery street. It is the intention of the Council to install the necessary plant at once, for which tenders will be invited. There will be two 50-light dynamos, although 75 lamps only will be at first installed. There will be about eight miles of wire.

OTTAWA, ONT.—Application will be made to parliament for the incorporation of the Alaska & Northwestern Railway Company to construct a steam or electric railway from Pyramid Harbor on the Lynn Canal, by way of the Chilkat Pass, and thence by the Dalton trail to Fort Selkirk in the Yukon district.



UNIVERSAL ADJUSTER FOR INCANDESCENT LAMPS AS USED IN SHOP WORK.

ST. CATHERINE, ONT.—At next session of legislature, incorporation will be asked for the Queenston, St. Catherines and Port Dalhousie Electric Railway Company, J. D. Cowper is solicitor for the company. The Niagara Central Railway Company has obtained permission to use the streets to extend their roads through to Beamsville. J. S. Gamble has made application to parliament for the incorporation of the Niagara & South Western Railway Company, with power to construct an electric railway from Niagara-on-the-Lake, St. Catherines and Smithville to Hagersville, with branches to Dunville, Cayuga and Queenston.

J. A. C.

Montreal, January 27, 1900.

A Universal Adjuster for Incandescent Lamps.

The illustration herewith so clearly represents the uses of a simple form of electric lamp adjuster in practical work as scarcely to need a description. The inventor of the simple device shown had found that, in construction work and inside wiring contracting, he was greatly troubled with the unreliable spring devices that were used for the purpose of adjusting the height and position of lamps suspended by cords. The consequence was the production of the little machine illustrated, which is called the "Two Balls" hanger. This consists simply of two weighted balls in each of which is a little pulley of vulcanized hard fibre, these being flanged to receive the lamp cord. By a simple arrangement the apparatus is made to take care of any ordinary lamp and shade within reasonable limits of weight and requires no delicate adjustment.

The illustration shows a man at work on a lacquering table with one of the lights held in position by this attachment, while another workman is making a search, having pulled out the cord to such a distance that he can bring the lamp close to the floor. In other words, he has in his hand, thanks to this arrangement, a little portable searchlight. The appliance is made by M. I. Vought, of La Crosse, Wis., who is also largely engaged in electric specialty and construction work.

Rifle Vibrations.

Our esteemed contemporary, *Electrical Engineer*, London, after quoting from Captain Wisser's article in the ELECTRICAL REVIEW on vibrations in rifles, comments as follows:

"From the photographic records reproduced by our contemporary we see that a very slight motion of the end of the barrel took place before the bullet had actually left it. A point near the stock of the gun had moved considerably in the same time. It is curious to note that the vibration of the muzzle is increased with the decreased quantity of powder, and at the same time the vibration naturally becomes more effective in altering the course of the bullet. The whole question appears to us to be largely dependent on the method of supporting the rifle, and on the balance of the same. The subject is one which should be carefully gone into for every type of rifle before its adoption, as the distribution of weight round the barrel may considerably affect the accuracy of the fire. The ideal arrangement would be one in which the centre of gravity of the whole rifle coincided with the axis of the barrel."

THE COMMON BATTERY SYSTEM.*

BY F. O. RUNYON AND F. J. SOUTHWORTH.

All of the gentlemen present are, doubtless, acquainted with the history of the telephone; and it may be that all are familiar in a general way at least, with telephone practice, past and present. But since the purpose of your visit is to inspect the common battery equipment recently installed in this building, it may not be amiss to describe briefly the common battery system and also the magneto system which has been superseded by the common battery in the Brooklyn, or, as it is now called, the "Main" central office district.

By the common battery system is meant a system in which all the battery for supplying transmitting current for subscribers' telephones is located in the central office.

The common battery is also used for operating the signals at the central office, so that to call the office it is only necessary for the subscriber to remove the receiver from the hook. It also permits the use of signals in connecting cord circuits, whereby the supervision of connections is made automatic and is not attended by the continual listening-in of the operator to ascertain if the subscribers are through talking.

In this central office district, to which about 3,000 subscribers are connected, the local battery has been removed from each subscriber's station, and current is furnished by a series of 11 storage cells of 1,250 ampere-hours capacity located in the central office.

Briefly, the method of operating for the old, or magneto system, is as follows: The subscriber's station is furnished with a magneto hand-generator, which, when operated by the subscriber, throws an annunciator drop at the central office. The operator makes the connection from the answering jack of this subscriber's line to the desired subscriber's line, using a pair of connecting cords. The pair of connecting cords also contains an annunciator drop, which is thrown when the subscribers ring off, if they do not neglect that important item. If the desired subscriber's line is in another central office, it is, of course, necessary to complete the connection over a trunk circuit to that office.

All the large switchboards are of what is called the multiple type. In this type of board all of the subscribers' lines entering the central office appear in jacks about every six feet on the switchboard, so that all the lines are within the reach of any operator.

This central office has a common battery board of the multiple type, and on which the signals are lamps controlled by relays. A subscriber connected to this central office wishing to make a call removes his receiver from the hook. This lights a small incandescent lamp known as the line lamp, located next to the answering jack of this subscriber's line, immediately before the operator. The operator makes the connection with a pair of connecting cords in the same manner as in the magneto system, automatically extinguishing the line lamp. Each pair of connecting cords is provided with two keyboard signals which are miniature incandescent lamps, and the operator by their being lighted or unlighted can tell whether the subscribers connected on these cords have their telephones on or off the hook. A lamp is lighted when the cord is connected to a subscriber's line and the receiver is on the hook. The lamp is extinguished while the telephone is off the hook, indicating that the line is in use.

In trunking between two common battery central offices this method of signaling is extended, so that trunk operators are informed automatically when the trunk shall be disconnected. In the temporary conditions of affairs, when some exchanges are on the magneto system and some on the common battery system, the full advantages of automatic signaling can not be obtained.

The underground cables carrying lines from subscribers' stations enter the building through iron pipes, and are connected to the main distributing rack on which the protective apparatus for the central office is placed. This rack has an ultimate capacity for 13,200 metallic circuits, and is arranged so that any pair of cable conductors can be cross-connected to any subscriber's line in the switchboard.

From the main rack, lead covered, wool insulated, cables carry the lines to the intermediate distributing rack on the sixth floor, where the switchboard is located. The purpose of the intermediate rack is to enable subscribers' lines to be arranged in such groups on the switchboard as may be desired.

On the same floor is a relay rack, upon which the relays controlling the line and other signal lamps are placed. From the intermediate rack lines are carried through the multiple board in cables containing 64 wires each, with silk and cotton insulation. Cables containing 84 wires each also run from this rack to the answering jacks and signals.

The switchboard and auxiliary apparatus are designed for an ultimate capacity of 4,900 subscribers' lines and 950 trunk lines. It is at present equipped with 3,000 subscribers' lines and 500 trunk lines.

The repeating coils in the cord circuits are placed on the rack in the power room; in which is also located the units for charging the storage battery, the storage battery itself, and the motor-generators for ringing telephone bells and for other signaling purposes.

The storage battery has sufficient capacity to supply current for two or three days in case of a breakdown, and the charging sets and signal machines are in duplicates.

The power room also contains the wire chief's desk, to which all trouble is reported and from which trouble is located and the necessary directions given to the maintenance force in order to enable them to clear it.

The main operating room contains the main switchboard, the toll-board and also desks of the manager, chief operator, etc.

At the toll-board calls for all points outside of Brooklyn and Manhattan Boroughs are handled.

[This exchange was described and illustrated in the ELECTRICAL REVIEW for November 1, 1899.]

*Extracts from a paper read before the New York Electrical Society, January 17, 1900, at a meeting held in the New York & New Jersey Telephone Company's Brooklyn Exchange.

Electric Railways in Berlin.

A scheme has been prepared for the construction of a system of underground electric railways in Berlin, says *Engineering*. The project, which has already been approved by the mayor and the traffic committee, will shortly be submitted to the municipal authorities, who will be asked to approve the carrying out of the works. It is proposed to construct two circle railways and two transverse lines from north to south and east and west respectively. The scheme provides for the building of the railways by private enterprise at the expense of the town, but whether they would be leased to a company or worked by the city authorities is a question for the future to determine. It is believed that the railways could be completed and opened to traffic in two years from the time of commencement, as was the case with the underground electric railway in Buda-Pesth.

Captain Lyons, R. E., in charge of the Geological survey of Egypt, has for some years been making magnetic observations during his journeys in various parts of Egypt. It is hoped that before long a systematic magnetic survey of Egypt can be undertaken.

EXPORT NOTES

It was reported recently that a Honolulu, H. I., company had ordered 25 automobiles to operate in the streets of that city. The report could not be confirmed.

The tramway lines of the Empresa del Ferro-Carril Urbano de Vera Cruz, of Vera Cruz, Mexico, have recently been acquired by an English syndicate with a capital of £50,000. The lines, which are at present operated by mule-power, are to be reconstructed into a well-equipped modern electric service.

It is stated in the *British and South African Export Gazette* that the provision of an electric transmission plant, capable of driving a 20-stamp mill, with pumps, winding gear, and other accessories, at an estimated cost of £10,000, is under consideration by the directors of Rezende, Limited, for their properties in Eastern Rhodesia.

Mr. F. H. Armstrong, of Dick, Kerr & Company, Ltd., London, is now in this country with a view to making additional purchases of equipment for the plant of the English Electrical Manufacturing Company, at Preston. Mr. Armstrong, it is stated, anticipates the placing of contracts for at least $100,000 worth of machine tools during his present trip.

The Hamilton Electric Light and Cataract Power Company, Ltd., of Hamilton, Ont., is reported to have placed a contract with Riva, Monneret & Company, of Milan, Italy, for supplying two powerful turbines. They are to be of no less than 3,000 horse-power each, and to be provided with hydraulic servomotor and automatic regulators. This order is said to have been secured by the Italian makers in spite of competition on the part of American and British firms.

Since the fact became known that the customs laws of France imposing a high duty upon printed matter to be circulated at the Paris Exposition for advertising purposes have been repealed by the French Government, many manufacturers have made application for space. It was stated a few days ago at the offices of the commissioner-general that all these applications are too late, as there are already some 7,400 American exhibitors, and that number will more than cover the space allotted to the United States. Germany, it is stated, will be the next largest exhibitor, they having already about half as many concerns as this country. England will follow with more than two thousand exhibitors, and as far as known Russia comes next. The quantity of printed matter which will be sent to Paris before April next will be very large.

The list just issued by the Light Railway Commissioners, of London, England, gives an idea of how much material and apparatus will be required for the construction of the proposed undertakings. The list shows that the application for provisional orders number 43. On 30 of these projected light railways it is proposed to use electricity as the motive power and on 11 of them steam will be used. Of the remaining two, one is to be run by mechanical power and the other by either steam or electricity. Of these 43 light railways, six are being promoted by the British Electric Traction Company, Ltd. The Hertford County Council and the Metropolitan Tramways and Omnibus Company, Ltd., are the promoters of four of the roads. The London County Council are promoting four. The longest of the projected lines is the Cinque Ports, an electric railway, which is to be nearly 68 miles long.

The importance of Finland, Russia, as a market for machinery can be judged by the fact that in 1893 the imports of machinery and tools reached in value $783,000. Since then the value has constantly increased until it reached $2,920,000 in 1898. A report in the *American Machinist* (said to be the latest obtainable) says that nearly 50 per cent of the machinery sent to that section of Russia is imported from Germany, while Sweden and Norway furnished about 20 per cent and the United Kingdom slightly less. France, Belgium and Denmark enjoy a share of such business. The United States shipments of machinery quite likely go through Copenhagen, Denmark, as none are recorded as being sent direct. The same report says that the city of Tammersfords promises to be one of the most encouraging fields for American machine manufacturers. It is already the most flourishing industrial centre of Finland. Its pulp and paper mills, its textile factories have sprung up and developed in a way which bids fair to insure a most prosperous future. To these factories and shops machinery manufacturers can safely look for profitable orders, provided the trade is canvassed in an adequate way. The Helsingfors Elektriska Belysning Aktiebola, of Helsingfors, is actively engaged in the importation of all kinds of electrical appliances.

Passengers Must Jump Off.

[*From Modern Mexico.*]

Street cars no longer stop during the noon rest.

ELECTRIC RAILWAYS

The car barn, at Holland, Mich., and all the cars, 11 in number, and the freight motor of the Holland and Lake Michigan Electric Railway Company were destroyed by fire a few nights ago. Loss $50,000.

The annual meeting of the stockholders of the Lykens & Williams Valley Street Railway Company was held at Williamstown, Pa., January 8, and the following directors were elected: H. A. Hoopes, William E. Fletcher, C. C. Cocklin, H. P. Hemler, John Oenslager, Jr. H. S. Hoopes was elected president; C. C. Cocklin, vice-president; John Oenslager, Jr., secretary, and M. G. Potts, treasurer.

The annual meeting of the Doylestown & Easton Railway Company was held January 2, and all of the officers were re-elected as follows: President, Harry J. Shoemaker, Esq.; vice-president, Samuel J. Penrose; secretary, Mahlon H. Stout, Esq.; treasurer, Samuel A. Hellyer; solicitor, E. Wesley Keeler, Esq. The five executive officers and Joseph Leedom, of Philadelphia, constitute the board of directors.

The annual meeting of the stockholders of the Colonial City Traction Company was held at Kingston, N. Y., recently. The following were elected directors: George Hutton, John N. Cordts, Luke Noone, Abraham Hasbrouck, August Belmont, Alvah S. Newcomb, G. D. B. Hasbrouck, John E. Kraft and Charles M. Preston. Hon. Charles M. Preston was elected president and George Hutton, vice-president.

To determine the best motive power for use on the Boston Elevated Railway as between the General Electric, Westinghouse and Sprague Systems, the elevated company is constructing a shed and two spur tracks in the vacant space inside the north station loop to be used in making tests with dummy trains in the subway between the hours of midnight and 6 A. M., when the subway is closed to regular traffic. The Manhattan Elevated officials will be represented at the tests.

At the annual meeting of the York, Pa., Street Railway Company it was shown that the receipts for 1899 were $63,439.98—receipts from passengers in 1898 were $58,262.98; and in 1897, $52,764.01, showing an increase over the previous year of $5,177.09, and over 1897 of $10,675.97. The following board of directors was elected: W. H. Lanius, Grier Hersh, George P. Smyser, John Fahs, L. A. Marshall, J. W. Steacy and H. H. Weber. A dividend of four per cent was declared upon the capital stock.

Mr. George Westinghouse and Dr. Hutchinson on the use of Refuse as Fuel.

The following interesting letter from Mr. George Westinghouse, president of the Westinghouse Electric and Manufacturing Company, recently appeared in the New York *Times:*

The bringing together of the gas and electric light and power interests in New York should result in great advantages to the public and to the interests so combined, provided the latest developments in gas and electric engineering are investigated and availed of. Among the numerous questions affecting the health, comfort and convenience of the citizens of New York (and of all communities, in fact) are three of especial importance, *viz.:*

The disposal of garbage, the abatement of the smoke nuisance due to the increasing use of bituminous coal for steam power purposes, and the securing of an adequate supply of water.

From statistics there appear to be created daily in New York about 500 tons of garbage, or at the rate of one-half pound per capita. Such garbage is about 20 per cent carbon and 80 per cent water. By a process which has been well demonstrated on a small scale, and which is being rapidly brought to a commercial basis, all of this garbage can be economically, and without offensive odor, converted into a fuel gas of great value. In the same apparatus and by the same process soft coal can be made into a gas suitable for power and heating purposes.

The fuel gas made from garbage and soft coal can be used to drive gas engines with electric generators, and the electricity thus produced can be used for light and to drive motors to the exclusion of the thousands of steam engines and boilers which make such demands upon the water supply, since the gas engine central stations can be so located that the water needed for engine-cooling purposes can be taken from the river.

Bearing upon these questions, and of especial importance, are the partially executed plans of the electric power and light corporations, *viz.,* the Metropolitan, Third Avenue and Manhattan Elevated Railways, and the New York Gas and Electric Light, Heat and Power Company and the United Electric Light and Power Company. If their present plans, which are fairly well-known to the engineering profession, are carried to completion, each will have one large steam station on the East River between Twenty-ninth street and the Harlem River, with about 75,000 horse-power of engines, boilers and electric machinery, making an aggregate of 375,000 horse-power, and which may be largely increased when the underground rapid transit railway is completed, and still further when the electric locomotive is used on all steam railways within the city limits.

If these corporations, which might as well buy electricity as the machinery, coal and water with which to produce it, were to unite in a common plan to provide the electricity needed in their operations by the adoption of the best available methods, the saving to each in capital expenditure would be very great, and the decreased cost of their supply of electricity would make an important addition to their earnings applicable to the payment of dividends; while, most important of all, the citizens of New York would have solved for them the garbage, smoke, and very largely the water questions.

I believe the contemplated plans of the corporations above named, which can be shown to be based upon an imperfect knowledge of the subject, will stand in the way of vast public interests, and, so believing, I have said to representatives of some of those companies that the near future would demonstrate the projected power stations and systems of electrical distribution incidental to the character of such stations, to be as far from the best as are the old cable systems for the propulsion of cars.

I write this letter because I believe these subjects are just now worthy of investigation, discussion, and elaboration.

Dr. Cary T. Hutchinson, of New York city, the well-known electrical engineer, replied to Mr. Westinghouse as follows:

The letter from Mr. George Westinghouse calling attention to the great advantages that would accrue to the citizens of New York from the use of garbage as fuel, and to what he considers to be the "imperfect knowledge of the subject" shown in the engineering plans for the large power stations, about to be erected on the East River, deserves some comment.

Mr. Westinghouse estimates the amount of garbage available daily in New York city at about 500 tons. He implies that this amount of garbage converted into gas and used in gas engines would be sufficient to supply a material part of the output of the great power plants that he refers to. Experiments made in England based on the burning in steam boilers of 26,000 tons of ordinary city refuse show that one pound of such refuse will make one pound of steam. On this basis, assuming the best engines and electric generators, twenty-five pounds of refuse would be required for each unit (kilowatt-hour) output of electric energy from the power plant.

Mr. Westinghouse, however, does not propose to use the refuse for making steam, but purposes converting it into a fuel gas. He gives no data as to the value of the refuse used in this way, beyond the statement that "all the garbage can be converted into a fuel gas of great value." It is simple, however, to give an approximate idea of the possible limit to the efficiency of a process of this kind.

Assuming the analysis of the garbage given—that is, 20 per cent carbon to 80 per cent water—the maximum theoretical heating value of one pound of refuse is very approximately 2,000 thermal units; if all this energy can be recovered in the form of a gas—that is to say, if the efficiency of the energy conversion from refuse to gas is perfect, and assuming a ratio of 20 per cent between the energy in the form of electricity and the theoretical energy of the gas—a high figure—it would require 8.5 pounds of refuse per unit (kilowatt-hour) of electric energy. This figure fixes the maximum theoretical duty of a pound of such refuse when converted into a gas and used in a gas engine. It is not probable that the actual commercial duty of the process will equal 15 pounds of refuse per kilowatt-hour.

That is, a consideration of the elementary principles involved shows a probable duty of 15 pounds of refuse per unit (kilowatt-hour) in comparison with 25 pounds, deduced from extensive tests on steam. This difference represents the possible improvement due to the use of gas engines.

Assuming then that a unit of electric energy can be obtained from 15 pounds of refuse, the 500 tons would yield about 67,000 units. As Mr. Westinghouse truly says, the aggregate power of the large steam plants mentioned is approximately 375,000 horse-power. The daily output of these plants will be approximately 2,500,000 units; in other words, the maximum result that could be got from the consumption of all the garbage of New York city in the way that Mr. Westinghouse describes, would supply about two and one-half per cent of the daily output of power from these stations alone. This is so trifling that it is hardly worth consideration, not being even sufficient to drive the pumps and auxiliary apparatus in the various power houses.

Looked at from another point of view, the daily demand for power from these stations will call for the consumption of nearly 3,500 tons of the best coal. Mr. Westinghouse proposes to use 500 tons of refuse to do the work of 3,500 tons of good coal.

Sparks from the Daily Press.

[*From the Binghamton, N. Y., Republican.*]

The street car tie-up in Troy gives the Trojans a chance to try their wooden horse again. If they fail to find it, they can ride on shank's horses.

[*From the Boston Advertiser.*]

The *Popular Science Monthly,* for February, contains an elaborate essay (illustrated) by William Baxter, Jr., C. E., on "What Makes the Trolley Car Go?" We have not read the article yet, but in Boston it was the subway commissioners, reenforced at a later date by the referendum.

De Rodays and De Castellane.

[*From the New York Evening Sun.*]

The long-distance duel by cable which is now going on, must be viewed with equanimity by the officers and stockholders of the company.

INDUSTRIAL NOTES

L. B. Allen Company, Chicago, have placed upon the market, in paste form, the Allen soldering stick, which is meeting with universal favor. Descriptive circulars, prices, etc., may be obtained free on application.

The Ericsson Telephone Company, 296 Broadway, New York, has sent out the second part of its Ericsson series of booklets, containing valuable telephone information. The booklets may be obtained, postage free, on application to the above address.

The Electric Appliance Company, of Chicago, reports a steadily increasing sale of the Packard lamps. "There is nothing in this world that brings results as quickly as advertising a good article," remarks the manager of the Electric Appliance Company.

John T. McRoy, 302 Broadway, New York city, is out with his monthly blotter calendar for February. The blotter contains the usual neat and pointed reference to the McRoy vitrified clay conduits which have become so popular throughout the United States.

The Standard Telephone and Electric Company, Madison, Wis., has issued its new catalogue for 1900. It contains an unusually complete list of apparatus as well as numerous strong testimonials regarding the company's product. The catalogue may be obtained, postage free, on application to the above address.

The Siemens & Halske Electric Company of America, has removed its Boston office from 73 Broad street to 72 Broad street, at the corner of Custom House street. Mr. E. T. Pardee, district manager, informs the ELECTRICAL REVIEW that he carries in stock, in all sizes, at all times the improved Duncan meters.

The Shelby Electric Company, of Shelby, Ohio, has just brought out a little pamphlet called "Useful Data for the Electrician," which will be sent to any one on application. It contains a large amount of interesting and useful data relating to incandescent lamps, among the pieces of information being a condensed wiring table.

The Central Electric Company, of Chicago, reports an increased trade in all lines of electrical goods, especially in American circular loom conduits and "Electra" carbons. As a consequence of this boom the company has procured a large line of both of the above products and is prepared to ship immediately on receipt of orders.

The New York & Ohio Company, Warren, Ohio, has issued a neat wall calendar for February which is embellished with a handsome photogravure. The calendar is issued to bring to the front the merits of Packard incandescent lamps and transformers and, in connection with the unique circular which accompanies it, seems calculated to carry out the idea successfully.

The Ward Leonard Electric Company, Bronxville, N. Y., has issued catalogue No. 1900, illustrating and describing the company's well-known rheostats and circuit breakers. Another publication just issued by Mr. Leonard is entitled "The Ward Leonard System of Control for Electric Motors," which is an interesting pamphlet to all who have to do with electric motors.

The McCormick Harvesting Machine Company, of Chicago, Ill., after a personal inspection of the Siegrist automatic oiling system at the power house of the Metropolitan West Side Elevated Railway Company, of Chicago, and other oiling devices, has awarded the Siegrist Lubricator Company, of St. Louis, the contract to equip its two new power houses with the Siegrist automatic oiling system.

The National Carbon Company, Cleveland, Ohio, has issued a handsome steel engraved calendar with the moonlight schedule for each month on each leaf of the calendar pad. The calendar also carries a perspective view of the company's immense plant at Cleveland, Ohio. Another calendar issued by the same company, is entitled "The Real Carbon Battery," and must be seen to be appreciated. Both calendars may be had by applying to the National Carbon Company, Lock Drawer L, Cleveland, Ohio.

The Sprague Electric Company, New York city, has contracted to furnish and install complete, for the Plymouth Cordage Company, two 75-kilowatt direct-connected generating sets, each consisting of a 14 by 14 Ames engine and a 75-kilowatt split-pole generator. The company has also received an order for two 30-kilowatt generators to be used in the works of the Whitehall Portland Cement Company, at Cementon, Pa. One of the Sound steamboat companies has ordered a Lundell generator to furnish 250 lights for one of its steamers.

A new gas machine, perfected by the L. E. Knott Apparatus Company, of Boston, has recently been announced. The instrument is arranged for the vaporizing of gasoline at low temperature by means of a water vaporizer. It can be used in any place where there is a water supply, apparently with absolute safety. It has been approved by fire insurance companies. It gives a flame on a Bunsen or Welsbach burner superior to ordinary illuminating gas. All who have use for a constant gas supply for heating purposes will be interested in investigating this new instrument.

The Montauk Multiphase Cable Company, 100 Broadway, New York city, has issued a neat little pamphlet in which it describes the splendid work done by its Montauk multiphase fire detective cable in the recent fire in Mr. Joseph Pulitzer's residence in New York. Through the operation of this cable in giving prompt alarm that the house was on fire the lives of 22 persons were saved. It has become an axiom among firemen that "Given five minutes' notice of a fire, it can be put out in the next five." It would seem that this fire detective cable would exactly fill the requirements in such a case.

The great impetus recently given to all technical trades and professions, by the commencement of a new era of commercial prosperity, has forcibly brought to the attention of the public the great value of technical education, acquired simultaneously with practical experience. The ambitious mechanic, so educated, can make immediate application of his technical knowledge and secure, in the shortest possible time, a lucrative position. The International Correspondence Schools, of Scranton, Pa., offer a system of instruction by correspondence which would seem to meet the requirements of the majority by supplying the education for which employers are willing to pay, and pay well.

Wright Discount Indicators—In the Fall of 1898 the Edison Electric Illuminating Company, of Boston, ordered some 1,500 Wright indicators, and applied the system to a large portion of their business. The result is shown by an order just placed for 2,040 meters of various sizes. That such a company, after a thorough trial of the Wright system, should then place an order for over 2,000 Wright meters, is a fact which should be carefully considered by every manager of an electric lighting company. The "G-I" company—as it is popularly known—last week brought out another booklet which summarizes in an attractive manner the uses and results of this instrument. Actual figures supplied from the statistics of many foremost concerns make exceedingly attractive reading.

The Emerson Electric Manufacturing Company, St. Louis, Mo., state that their Catalogue No. 2110 is now in the hands of the printer, and will be ready for distribution within a week or 10 days. Catalogue No. 2110 describes alternating-current fan motors and ceiling fans of the 1900 model, and the Emerson Company feel confident that their 1900 model motors will be even more satisfactory than the highly improved machines placed on the market by them in 1899. As the main office of the Emerson Electric Manufacturing Company is located in St. Louis, Mo., they have been unable to serve their eastern customers as promptly as they would desire, and have consequently opened a branch office at 136 Liberty street, New York city, and will carry a large stock of all regular motors for prompt shipment from New York. This branch office is in no sense a mere sales agency, one of the officers of the Emerson Company being permanently located in New York, devoting his entire time to the needs of the eastern trade. Any inquiries in regard to the new model Emerson motors, addressed to the branch office, at 136 Liberty street, New York city, or to the main office, in St. Louis, Mo., will receive prompt attention.

ADVANCE INFORMATION

Electric Railways.

CONCORD, MASS.—The Selectmen have granted a franchise to the Lexington & Boston Railway Company for a road to start at the Concord-Bedford line and continue over the Bedford road and Bedford street to Monument square in the centre of the town. The franchise provides that there shall be a half-hour service in the daytime from May to December, and hourly service on Sunday the year round.

RYE, N. H.—Contracts have been let for the construction of a large power house for the Portsmouth, Rye & Hampton Electric Railway. The building will be 160 by 40 feet and will be located at Rye Centre. A large storage battery will form a part of the equipment and it is expected that the building will be finished in May.

ATLANTA, GA.—The Atlanta & Roswell Electric Railway and Power Company, capital $500,000, has been incorporated. The incorporators are H. L. McKee, W. W. Draper, W. H. Harrison, S. Y. Stribling, Charles A. Geiger, S. Crowley, George W. Wing, William S. Ansley, I. Y. Sage and C. W. Ansley. The line will be over 25 miles long extending from Atlanta *via* Buckhead through the counties of Fulton, Milton, DeKalb and Cobb to Roswell.

NEW BEDFORD, MASS.—The Taunton, Myricks & New Bedford Air Line Street Railway Company, capital $200,000, has been formed. The board of directors are B. G. Grinnell, Frank A. Rouse, Albert M. Field, Henry G. Crapo, William N. Dean, L. P. Churchill and James P. Peirce. The line will extend through Taunton into the town of Berkley to Myricks village, thence into Lakeville to Freetown, East Freetown to Long Plain, Fairhaven, and over the Fairhaven bridge into New Bedford.

COLUMBUS, OHIO—It is reported that the entire capital stock of the Columbus, London & Springfield Electric Railway Company, amounting to $1,000,000, has been subscribed, largely by Boston men. Work will begin at once and it is expected that the road will be completed within a year. It is rumored that Mr. Hart A. Fisher will be the general manager of the road.

BOSTON, MASS.—Application has been made for the incorporation of the Boston & Brockton Electric Freight Company, with a capital stock not to exceed $150,000.

LAKEWOOD, N. J.—It is proposed to build a trolley line from Freehold to Shrewsbury to connect with the Redbank & Long Branch Road.

ATLANTIC CITY, N. J.—Philadelphia capitalists are considering the building and operating of a trolley line along the beach.

TRAVERSE CITY, MICH.—The Traverse City & Leelenau Railroad Company, with a capital stock of $300,000, has been organized. The road will run between Traverse City and Northport, a distance of 30 miles, and will touch at all the popular resorts in that section.

BATTLE CREEK, MICH.—An electric railroad may be built from Battle Creek to Hastings.

TRENTON, N. J.—The Puerto Principe Electric Company and the Puerto Principe Tramway Company have been incorporated, each with a capital stock of $400,000, fully paid. The companies are controlled by the same interests and will build a trolley road in Puerto Principe. The electric company will be the operating company and the other will be the construction company.

JEFFERSONVILLE, IND.—The Jeffersonville City & Suburban Railroad Company has been incorporated with a capital stock of $25,000, by T. W. Scott, C. N. McGuire, O. C. Barth, R. W. Morris, E. S. Gwinn and H. W. Heath, all of Jefferson.

HONEOYE FALLS, N. Y.—The property of the Lima and Honeoye Falls Electric Railroad and Light Company plant has been sold at receiver's sale. The property was bid in for $35,000 by Frank Williams, of Buffalo, representing capitalists of that city. C. F. Whiting, who has had charge of the property for the past year will remain as superintendent.

Electric Light and Power.

NEW YORK CITY—The River District Light, Heat and Power Company, of New York city to manufacture gas and electricity for sale in New York city; capital, $50,000. Directors: James Douglas, Cleveland; H. Dodge, E. M. Johnson, William H. Yale, and John Jay McKilvey, of New York city.

ANNAPOLIS, MD.—A bill has been introduced in the State Senate which purposes to amend the charter of the Chesapeake Electric and Water Company, of Baltimore. This bill provides that the company be authorized to supply electric current for lighting, heating and power purposes to any and all parts of Baltimore city and county. The act gives the company perpetual existence and authorizes an increase in the capital stock to $5,000,000.

RALEIGH, N. C.—The Kingston Electric Company has been incorporated with a capital stock of $10,000. The company proposes to operate an electric light plant in Kingston. The incorporators are B. W. Canady, S. H. Abbott, J. W. Grainger, L. Harvey, A. Mitchell, H. O. Hyatt, F. A. Whitaker, W. C. Fields, J. B. Temple, E. M. Hodges, Louis Einstein, D. Oettinger, T. W. Mewborne, J. E. Hood, L. Hines, E. F. Cox, J. A. McDaniel, H. C. Harmon, G. E. Kornegay, Junius Stevenson.

DENVER, COLO.—Longs Peak Power Company; furnish electric power; capital, $50,000; incorporators: S. Eastwood, W. H. Davis, W. T. Boyd, all of Denver.

CHARLOTTE, MICH.—W. P. Engel, for the past five years sole owner of the Charlotte Electric Company, has sold the plant to Hugh A. Holmes, of Detroit, and John C. Farrer, of Brighton, price $40,000. The new company will be known as the Charlotte General Electric Company and has filed articles of incorporation with the secretary of state. Its capital stock is $50,000.

HOBOKEN, N. J.—TheMunicipal Light, Heat and Power Company has applied to the Hoboken Common Council for the privilege of erecting poles and placing conduits in the streets for supplying the city and citizens with light, heat and power. Congressman William D. Daly, representing the company, said that it would agree to supply light at a lower figure than that now paid, and would agree to sell the plant to the city at the end of five or ten years.

NEWPORT NEWS, VA.—Another electric light and power company is being organized here to run in opposition to the Peninsula Electric Light and Power Company. It is reported that over $50,000 has already been subscribed.

Miscellaneous.

BOSTON, MASS.—The Oxygen Explosive Company has been incorporated in Delaware to manufacture all kinds of wares and to construct telegraph and telephone lines. The capital stock is $500,000.

NEW YORK CITY—The Bunnell Telegraphic and Electrical Company, of New York city, with a capital of $200,000, has been incorporated to manufacture telegraphic supplies. The directors are Mary T. Bunnell and DeWitt C. Bunnell, of Brooklyn, N. Y.; F. R. Green, Fredonia; Charles E. Merritt and Albert J. Wise, of New York city.

SAN FRANCISCO, CAL.—The Electro-Therapeutic Company, with a capital of $75,000, has been incorporated to manufacture and sell electrical apparatus.

Telephone and Telegraph.

TARBORO, N. C.—The Carolina Telephone and Telegraph Company has been organized under the laws of North Carolina with a paid up capital of $50,000 and an authorized capital of $150,000. W. H. Powell, Jr., Tarboro, N. C., president; A. McDowell, Scotland Neck, N. C., vice-president; Geo. A. Holderness, Tarboro, N. C., secretary, treasurer and general manager; executive offices at Tarboro, N. C. The company has purchased the entire exchanges, toll-lines, etc., heretofore belonging to the Tarboro Telephone and Telegraph Company, Fayetteville Telephone and Telegraph Company, Carolina Telephone Company and Scotland Neck Telephone Company. It is the purpose of the above company to build extensive toll-lines.

ELECTRICAL PATENTS

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED JANUARY 30, 1900.

642,102 Electric signaling device for crossings; O. Fuchs, Dresden, Germany—A crossing signal system, comprising an electric railroad provided with intersecting lines, trolley-wires for supplying current thereto, insulated sections in said trolley-wires adjacent the crossing, independent signals through which current is supplied to the insulated sections of the intersecting lines, and a common main for supplying current to both signals and insulated sections.

642,123 Dynamo-electric machine; E. W. G. C. Hoffmann, Charlottenburg, Germany—The stationary member, a roller-mounting for said stationary member, permitting the same to be rotated, and means for normally preventing the stationary member from being rotated.

642,159 Electric switch; I. Robbins, Camden, N. J. — A pivoted switch, the trolley-wire and the fixed contacts, a trolley and its pole, swinging weighted contacts on said pole, independent of the trolley and electrical devices and connections for actuating said switch.

642,164 Alternating-current wattmeter; K. O. F. Schrottke, Berlin, Germany.

642,167 Electric sparking plug for explosive engines; F. R. Simms, London, England.

624,169 Grounding shoe for electric wires; T. H. Stokes, Lincoln, Ill.—A grounding device for an electric wire, comprising a shoe sharpened at its lower end and having a transverse hole for receiving a grounding wire.

642,216 Unit multiple system of control for electric railways; F. C. Esmond, New York, N. Y.—A pair of conductors extending through a car, a motor carried by said car and having one of its elements between said conductors, a controller carried by said car having two adjacent points which have separate connections with said conductors, whereby when the arm of the controller engages said points current will be sent through the element between the conductors in opposite directions.

642,252 Automatic electric heat and fire-alarm system; R. P. Osgood, Methuen, Mass.

642,257 Emergency throttle-valve; J. R. Reynolds, Hartford, Ct.

642,274 Magnetic brake; T. von Zweibergk, Cleveland, Ohio.

642,362 Signal; Mathias Pfatischer, Philadelphia, Pa.

642,364 Electric motor; E. S. Pillsbury, St. Louis, Mo.—A field-magnet core provided with polar projections, main coils which include a plurality of said polar projections in the formation of each pole, and high-resistance phase or starting coils laterally displaced relative to the centre of each pole, said phase-coils including a plurality of polar projections in each pole.

642,379 Electric signaling apparatus; H. W. Souder, Tamaqua, Pa. —A plurality of track-sections, two automatic electrically-operated signals for each section of track, located one near each end thereof, and means whereby the passage of a car onto or off of any particular section of track will shift the signals of said section and illuminate the signals of the adjacent ends of the neighboring track-section.

642,408 Sanitary attachment for telephonic appliances; A. J. Wolff, Hartford, Ct.

642,414 Manufacture of electrical resistances; J. F. Bachmann, Vienna, Austria-Hungary—Consists in forming a plastic mass from a mixture of a conductor and a non-conductor of electricity, molding or otherwise converting the compound into the shape desired, drying and embedding the dried article in carbon and heating it to a high temperature.

642,424 Maximum indicator; C. R. Brown, Dedham, Mass.—A maximum indicator, comprising an electric meter having a movable member, a retarder for said member and a motor for said retarder controlled by said member.

642,521 Junction-box; E. T. Greenfield, New York, N. Y.—Composed of two parts, one of which is provided with openings and the other with corresponding disks adapted to close said openings, when the two parts of the box are put together.

642,551 Mechanism for driving dynamos for electric lighting on railway cars; Patrick Kennedy, New York, N. Y.

642,563 Electrical measuring instrument; F. M. Bennett, New York, N. Y.—A coil, an excitable metallic material set above the coil, and provided with bearings projecting downward and having eccentrically-located pivots so that the outer portions of the excitable material will work respectively in and out of said coil, the said excitable material being provided with an index-finger, whereby a rocking and eccentric motion of the excitable material is produced.

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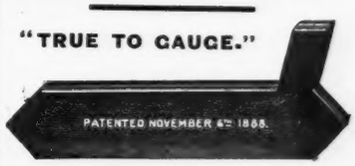

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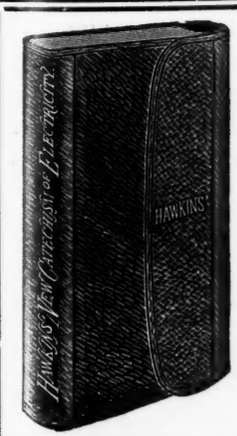

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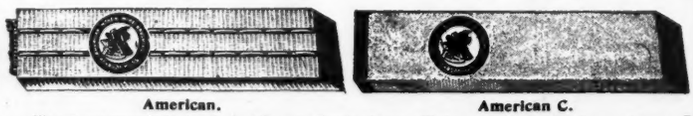

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